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SCIENCE EDUCATION

THE SCIENCE MAGAZINE FOR ALL SCIENCE TEACHERS
FORMERLY GENERAL SCIENCE QUARTERLY

Predictions for the Next Ten Years in Science Education

Relative Claims of Natural Science and of Social Studies in the Secondary School Curriculum

Science in the Rochester Public School of the Air

Need for a National Publication for Science Teachers

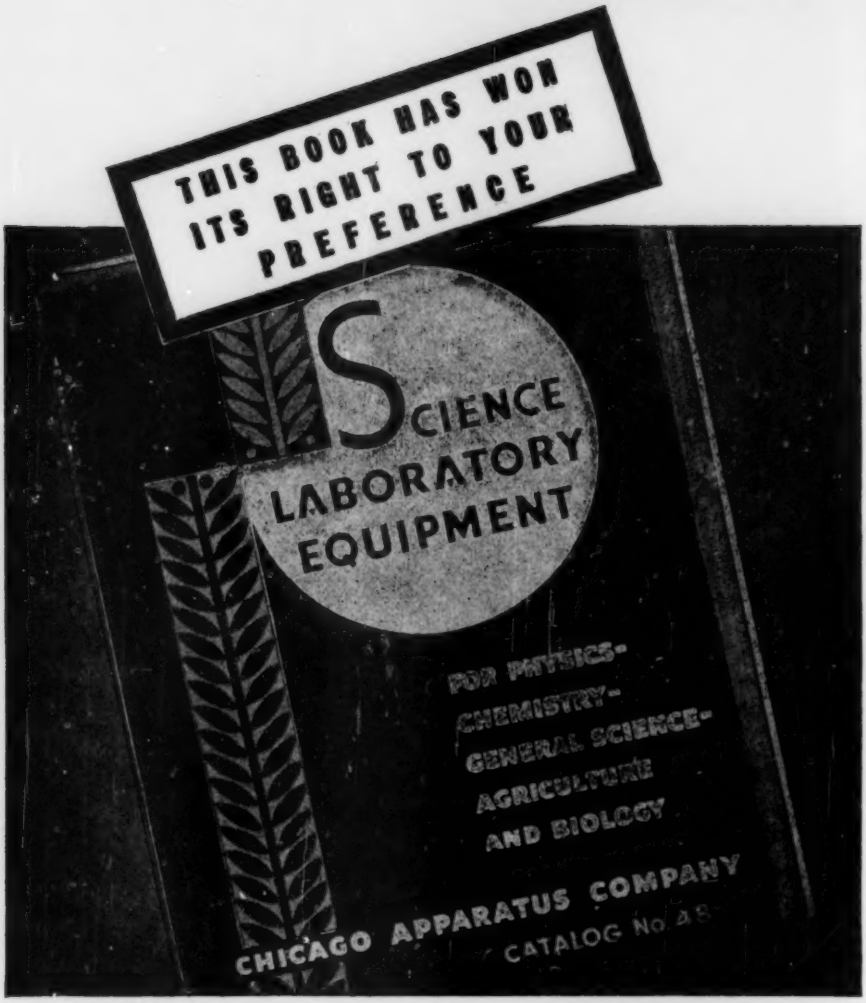
Bibliography of Research Studies Relating to Science Education for 1934, 1935 and 1936

Classroom Notes for Science Teachers

VOLUME 21

NUMBER 2

APRIL 1937



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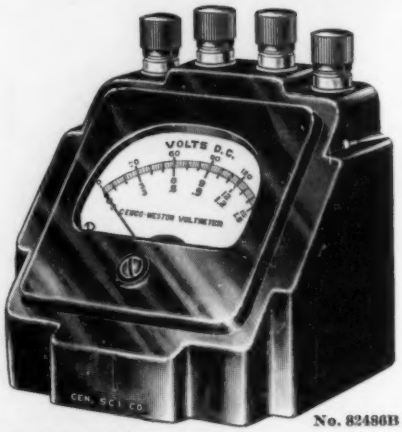

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Science Education

THE NEXT TEN YEARS IN SCIENCE EDUCATION*

OTIS W. CALDWELL

Professor Emeritus, Columbia University, and General Secretary of the American Association for the Advancement of Science, Boyce Thompson Institute, Yonkers, N. Y.

The problem. Your Committee in asking me to become a prophet regarding science education almost took the task out of the field of prophesy by the shortness of the period which they asked me to consider. If the period were long, one might give range to his imagination with the comforting knowledge that the check-up will not be soon enough to embarrass him. As it is, I shall discuss a few of the tendencies which appear fairly certain to produce changes in science education in the decade just ahead of us.

The vocabulary used in science education will again become more complex, but also more useful. Two or three decades ago, teachers, texts, and magazines used vocabularies, parts of which were foreign to the students. Texts were prepared by those who were primarily subject specialists. They believed that those studying their subjects should use the technical terms belonging to the subjects of study. Even if the technical language was difficult, its difficulties constituted part of the tasks the student must master. Their texts might appear unscholarly if devoid of the accepted technical terms common to those known as the devotees of the subject concerned.

Then came the excellent studies of the vocabularies that are common to students of different ages. Clear evidence was presented that many pupils could not hope to understand the ideas expressed in their school work since so many words used were unknown to them. The rush toward simple vocabularies followed, and is still upon us. The common and meager vocabulary of people who are not far above mere literacy has become one measuring criterion of acceptability of published material to be used in science study. Teachers and pupils who have severe limitations in English have capitalized their weaknesses whenever they found terms unknown to them. On the other hand, those who prepared material for publication oftentimes sought to express their ideas so as not to surpass the mediocre limits of that mass of people who compose the majority.

No complaint is made against this important change, provided we do not long remain in this changed condition. We have already begun to rise from this submergence below the level of the average or less than average linguistic possession. I believe we shall continue to rise, and predict that when another decade has passed, the science vocabulary of common usage will be far richer and more extensive than that which is now regarded as desirable.

This prediction is based upon evidence which is now appearing. The best students and best teachers desire and need vocabularies which shall grow as rapidly as do their new thoughts and experiences. In many cases the alternative to new terms is found only in devious, wordy and awkward phrases which are made up awkwardly of several common words. Even when new ideas are thus labeled, the phrases often serve as very general but not clean-cut and satisfying expressions of the ideas concerned. New ideas often call for new

* Presented at the meeting of the American Science Teachers Association, Atlantic City, December 31, 1936.

terms. In my own teaching I do not recall any case in which students failed to welcome the proper terms in which to house new ideas, provided the ideas were first quite clear. It is assumed that no one will now advocate mere memorizing of scientific terms just because they appear in dictionaries of science. But we shall see more and more definite and extensive plans for vocabulary building, far exceeding those now beginning to be used. We shall have the upper third or upper half of our students understanding and regularly using a science vocabulary far beyond what is now regarded as the minimum essentials. Our present apparent satisfaction with the mediocre in vocabulary will have passed.

A plan for coherent and cumulative science instruction will be in general use. The desire for a coherent series of several years in science teaching has made slow progress in actual practice. Over twenty years ago, in *School Science and Mathematics,* there was published a committee report which advocated coherent four-year high-school courses in science.[1] The sciences then in use were highly specialized. They were not coöperative. There were many special sciences seeking places in school programs. The situation was marked by severe competition between the advocates of special science courses. The efforts that were made to direct attention toward pupil needs of coherent and cumulative instruction in science were sometimes obscured in the confused advocacy of different science subjects. Some advocates are still chiefly concerned about the welfare of their special subjects, not about science as a means of education. Most of us, however, have discarded the vested-interest attitude of special sciences of that earlier period, but we also desire that really good things to do may not be discarded simply because they have existed for a long time. What now seems to be ahead of us? We may gain perspective for an answer by stepping back a little so as to get the view.

1. Elementary-school Science. In the elementary schools, the unplanned or poorly planned study of nature has largely given way to definite planning. Widely different plans are in use, but practically all of them are characterized by the expectation of considerable outcomes of fairly measurable types. In the best school systems there now are definite courses in elementary science.

2. Junior-high-school Science. In the junior-high-school years, efforts have been successful in developing and gaining recognition for foundational general courses. These have been developed in part by experimental methods, and therefore have somewhat more secure standing than could be claimed for the courses formerly used in these years. It should be made clear that the desirable element of tested trial has not been sufficiently used. More careful, less subjective, and better tested experiments will probably produce important subject-matter and teaching changes in junior-high-school science. It is altogether likely that ten years from now we shall look upon our present junior-high-school science instruction as having been important steps in the right direction. As elementary-school science takes more definite form, and as its proved results become more tangible, junior-high-school science will take more account of it as part of its own body of practice. A proved and tangible product from elementary science is necessary for any instructional coherence with junior-high-school science. Buoyant advocacy of the beauties of science for children may help, but does not insure measurable results.

Within the junior high school, coherent and cumulative instruction has been realized more fully than elsewhere. This will doubtless increase. Notwithstanding the asserted differences in subject-content, and in devices for effective instruction, we have arrived at a reasonably well-defined body of subject-content, and somewhat less well-defined instructional procedure for junior

[1] "Preliminary Report of the Committee on a Unified High School Science Course." *School Science and Mathematics* 14: 166–168; February, 1914.

high schools. Even the frequently revised courses of study seem to follow rather closely certain accepted units of experience and thought materials. The strikingly wide divergence from this common body of material are usually relatively temporary in their use. The enduring nature of this body of subject material may be questioned, but it is now widely recognized in use. It is not likely that extensive divergence from it will take place rapidly. Its coherent and cumulative features are steadily improving, and these under the recently applied term, integration, will surely be further developed. The ways through which junior-high-school teaching is done, are likely to undergo many changes. This junior-high school science can be fairly well counted upon as a basis when we turn to consideration of senior-high-school science.

3. Senior-high-school and Junior-college Science. A more daring prophesy than I am willing to make might portend a complete upset of special science courses in this field. This does not seem to be immediately ahead of us. Certain considerations are pertinent. The foundational general courses of junior high school deal with significant units which draw from all the special sciences. The names of these units suggest their general nature and wide significance. Within the junior-high-school courses there is progression toward more intensive studies. It is conceivable that this same type of topical studies might be extended into senior high school and junior college, and at a dozen or more places experiments are being conducted upon this plan. For example, in the experimental work of Los Angeles, the 11th and 12th years' work in chemistry and physics are designated as two years in physical science, with the following as the unit topics under which the work is organized. "Water Purification," "Petroleum Industry," "Electroplating and Electroforming," "Chemical Sources of Electricity," "Modern Methods of Communication," "Conquering the Air," "Artificial Refrigeration," "The Evolution of Lubrication," "The Mystery of a Magnet," "The Evolution of Textiles," "Lighting the World," "Paints," "Photography," and "The Rubber Industry."

Measured evidence is not yet available to show results, and the discussion is still mainly in the realm of hypothesis and personal opinion. Topical or unit foundational courses have been supposed to be the foundation for more specialized and more intensive later studies. Such specialized studies are now in use, and most convincing evidence will be needed to effect their displacement. The more mature students would seem to be better served by the more exacting special fields, but this is argument, not tested evidence. That special sciences require much adjustment to modern needs all will agree. This field has had less real thinking and experimentation applied to it than have the science courses at the junior-high-school levels. The certainty of assertions about senior-high-school science have thus far come mainly from subject specialists who have not conducted tested experimental work with pupils of the ages concerned.

Important changes in the training of science teachers are needed and probably will be made. This will apply both to inexperienced teachers and to those in service. These needs relate to an increasing science scholarship, to an increasing professional efficiency, and to ability to demonstrate to administrative and financial agencies the kinds of informed support required for effective work in science. Too often we see the sad picture of young and poorly trained teachers fumbling with subjects they have not studied seriously, and depending upon highly detailed texts and tests to accomplish what the crippled teacher alone cannot possibly accomplish. Texts and tests were forced to be what they now are. As rapidly as teacher scholarship and professional efficiency improve, texts and tests will become more fundamental and more comprehensive. At present these must guide and provide for teachers, many of whom would be

helpless in the presence of a class without these crutches for those who cannot stand alone. The best texts have undoubtedly made large contributions to improvement of science teaching. It is no accident, however, that those science teachers who possess superior scholarship are the ones who find no entirely suitable text for their classes. This is most encouraging and will become increasingly true as sound scholarship is extended.

The last two decades have overemphasized the taking of courses in education. Science teachers have even taken advanced degrees without any considerable accompanying advancement in knowledge of science. Better balance and better coördination will be sought so that teachers grow both in science knowledge and in its educational uses.

The best science teachers know that their own education can never be completed. Any increases they make in knowledge or effective teaching merely enlarge their horizon so as to include new regions to be examined. It is possible that society, which is now so concerned about adult education, can make its largest gains by having teachers themselves engage constantly in their own adult education.

The question of attitudes might have been expected to appear first in this discussion by those of you who have followed my own work for the past decade. It was not delayed because of relative unimportance, but partly because of less certain knowledge about it. How people respond to personal and group problems is very important. Their habits of response guide them in what they do. One may learn to change his usual responses and may even practice this changed way until it, in turn, may become a guide. These guides to thinking and acting may be such as the almost unconscious reflexes of catching a baseball, or such as the conscious insistence upon evidence before accepting a theory regarding the heat of falling meteors. But what we mean by attitudes falls within the higher range, and does not include reflexes and bodily habits. Whatever the definitions of attitudes may be, science is concerned with the qualities which call for reasonableness as compared with the opposite. That is, valid reasons for conclusions and actions are asked by those who possess the attitudes we seek.

Therefore, we have organized instructional procedure to the end that students of science may develop more of the attitudes which may perhaps cause them to live more regularly under the guidance of proved knowledge. This would seem to be at the foundation of making science a way of living, instead of being merely organized and proved knowledge.

It would be a rash enthusiast who would claim that the next ten years will largely enhance the teaching of desirable attitudes. There will be those who believe in teaching attitudes who will proclaim the millenium. Scientists know, however, that changes are usually slow in those attitudes which control belief and conduct. So far as now known, attitudes develop from no end of separate experiences, and experiences cannot be attacked "en masse." It is the unending series of separate experiences, properly met, from which attitudes may be derived. The plans already incorporated into science teaching should produce a measurable change during ten years. Any plus change in desirable attitudes will indicate progress, but society ten years from now will not be a wholly factually-guided society even though science teachers will have made substantial progress in teaching desirable attitudes.

I have dealt with four of the dozen or more topics one would like to discuss when thinking of science teaching ten years from now. Possibly one of the best achievements after another decade will be a speaker's capacity to discuss science teaching so much more cogently than I have done, that this paper will serve its best purpose as a small record of what was thought by some of us in our day.

THE RELATIVE CLAIMS OF NATURAL SCIENCE AND OF SOCIAL STUDIES TO A CORE PLACE IN THE SECONDARY SCHOOL CURRICULUM

A.—FOR NATURAL SCIENCE*

BY OSCAR RIDDLE

Carnegie Institution of Washington, Station for Experimental Evolution, Cold Spring Harbor, N. Y.

I should later regret this occasion if, at the outset, I failed to record my own conviction that social studies well deserve a place in the curriculum of every secondary school. Both history and social science deal with man, with groups of men and with vital human relationships — thus often touching aspects of that most evolved species which is also the special concern of biological science. Again, one welcomes an opportunity to record a considered opinion that a secondary-school curriculum which does not provide for good training in civics is itself a crime against good citizenship.

With this said I become free to discuss the claims of the natural sciences, as against the claims of social studies, to a core place in secondary education. By way of vouching for some personal familiarity with the phase of education now under discussion, I may state to this audience that in my early years I taught chemistry and biology in the High School of San Juan, Porto Rico, and biology in the Central High School of St. Louis, Missouri.

It is obvious that this discussion can have significance only in relation to what is conceived to be the legitimate aims, in particular, what is the leading or central aim, in secondary education. This hidden "y" in our equation—our subject—must unfailingly influence and condition all that is said here. I may at once indicate my own general concept of the central aim of secondary education. To educate at the high-school level is to kindle power and understanding in immature but growing minds. In simplest terms, the task is a quite biological one, that of using materials at hand for facilitating mental development at a life-stage at which such further development is possible. Unless the secondary school has led the youth to an understanding of himself and of his place in nature it has withheld or pilfered from him his modern birthright; if he entered this school with normal heredity and leaves the school without desire and capacity for sustained mental and physical effort he has been robbed. It can, of course, be admitted that present conditions force most of us to do less than our best and we must now pilfer a little.

It would be most useful if a few men throughout the country could and would be good enough to quantitate for us the extent to which present curricula and practice educate, and the extent to which they warp and opiate and pander and plunder. At least one large aspect of this educational "waste" has been evaluated recently by Tildsley for the comparatively good high schools of New York City.

Few will take exception to the following statements made three years ago by Dewey in his discussion, "The Supreme Intellectual Obligation."

> "We have broken with the intellectual traditions of the past and the mass of men have not had the nature of the change interpreted to them, although science set the terms on which men associate together. . . . The field of education is immense and it has hardly been touched by the application of science. There are, indeed, courses in science installed in high schools and colleges. That much of the educational battle has been won, and we owe a great debt to those who waged the battle against the obstacles of tradition and the inertia of institutional habit. But the scientific attitude, the will to use scientific method and the equipment necessary to put the will into effect, is still, speaking for the mass of people, inchoate and unformed. The obligations incumbent upon science cannot be met until its representatives cease to be contented with having a multiplicity of courses in various

* Address before American Science Teachers Association, Atlantic City, December 31, 1936.

sciences represented in the schools, and devote even more energy than was spent in getting a place for science in the curriculum to seeing to it that the sciences which are taught are themselves more concerned about creating a certain mental attitude than they are about purveying a fixed body of information, or about preparing a small number of persons for the further specialized pursuit of some particular science. . . . There is, moreover, a virgin field practically untouched by the influence of science. Elementary education is still a place for acquiring skills and passively absorbing facts. It is generally now admitted that the most fundamental attitudes are formed in childhood, many of them in the early years. The greatest indictment that can be brought against present civilization, in its intellectual phase, is that so little attention is given to instilling, as a part of organic habit, trust in intelligence and eager interest in its active manifestation. I take little interest in demonstrations of the average low level of native intelligence as long as I am aware how little is done to secure full operation of what native intellectual capacity there is, however limited it may be. Speaking generally, it is now everywhere subordinate to acquisition of special skills and the retention of more or less irrelevant masses of facts and principles—irrelevant, that is, to the formation of the inquiring mind that explores and tests."

Conceiving the central aim of education at the high-school level to be as already stated, I must regard the natural sciences as of greater significance than social studies for three reasons: (1) Both the scientific method, and the discrete materials with which that method deals, are more favorably encountered in the natural sciences. (2) The high degree of precision instinct to those sciences—particularly of physics, chemistry, astronomy—gives these subjects unrivalled relationships to tests and proofs, and unexcelled examples of conquests made by the mind of man. (3) And finally, biological science, or rather an enlarged life-science, is the special and sole source of data which traces and reveals the history of the child's own body and mind; it is, therefore, the intimate material required for a liberation of the growing mind.

Now with the giving of these three reasons I think the case for "natural science" is actually stated. In some respects I would regard it as unfortunate if my own further discussion should divert attention from those three summary statements. If those commendations are true it follows that the subject-matter of natural science is unrivalled in its suitability to contribute "to the inchoate and unformed mass of people the scientific attitude, the will to use scientific method, and the equipment necessary to put the will into effect"; it is likewise unrivalled as a revealer of just what it is that has made us "break with the intellectual traditions of the past"; and also unrivalled in early youth as an agent for "forming the enquiring mind that explores and tests."

Some good statements concerning the rightful place of one or another of the natural sciences have already been written and published by others. You of this audience have doubtless read them. I myself,[1] on the first day of this year, have stated the case for the life-sciences more fully than that which can be done here. Nevertheless, in some respects, I shall wish, at this time, to supplement that earlier statement.

Before entering upon some special discussion of life-science in its bearings in secondary education let us be reminded that to a considerable extent the building of a science of sociology is dependent upon the solid establishment of biological and psychological principles. A British sociologist[2] has indicated that the present state of sociology is similar to that of biology two hundred years ago. His book contains great masses of facts but lacks an adequate method to deal with them. At some future time sociology will have some fine ripe fruits, probably highly potent and mentally stimulating to youth and surely of great value to citizenship. At the moment it would be possible to give some support to the thesis that the best things of sociology are better adapted to the sifting struggles of graduate students and their trained leaders than to broadcasting in secondary education.

Getting on with our subject implies awareness of the present state of secondary

[1] Riddle, Oscar. "The Confusion of Tongues." *Science* 83: 41–45, 69–74; January 17, 24, 1936.

[2] Dawson, Christopher. *Science for a New World.* New York: Harper and Brothers, 1934.

education, and some specific items of desirable change. With reference to actualities I quote from President Hutchins: "However diversified the curriculum below the junior year of college may be, the core must be a good general education. We know that such a thing does not exist today. What we find instead is a series of short unrelated courses comprising a smattering of miscellaneous facts, which leaves the student uneducated and, except perhaps in the spasmodic exercises of memory, untrained." During the past two or three decades educators have unfortunately succeeded in placing a morsel of everything on the platter of secondary education—the offerings in this country having been increased from 18 subjects in 1905 to 156 subjects in 1928. From the interested standpoint of those who, through research, devote themselves to the building of the natural sciences this means that: During the precise period of man's most substantial triumphs in those basic sciences which deal with man's analysis and conquest of nature, the various natural-science subjects—with their great potential contribution to mental power and discipline—have been slowly displaced in the secondary-school curriculum by every titillating thing from fragments of Spanish to blowing the bugle. Let us set it down factually, without comment, that this same period embraces the rise and dominance of Teachers Colleges and Schools of Education in this country.

There has been and there is a procedure which is alternative to placing a bit of everything on the educational platter. By way of illustration I shall try to suggest the truly educative drive obtainable from a continuous four-year secondary-school course in life-science. If later this appears to you unlikely "to kindle power and understanding in immature minds"; if unadapted to lead to "the scientific method, and the will to use the scientific method"; if it fails either to indicate or to clarify our "break with the intellectual traditions of the past"; and if little apt to "form the enquiring mind that explores and tests," you can easily reject it.

A course in life-science would begin with the earth as a burning fragment of the sun. And its early chapters would deal with the physical results of the cooling of this fragment. In the superheated gases of the new-born earth only a few chemical compounds could possibly exist and present knowledge of the sun gives the clue to their identity. With progressive cooling of the little sun which became the earth more and more chemical compounds must form, and important parts of that story are at hand. When cooling progressed to a stage at which water could exist in the liquid state, an inevitable and almost limitless series of new compounds must have begun to form. Many of these are identifiable; and they are found to include some quite simple organic compounds which had to enter into the first living matter and which still continue to sustain it. Obviously, some simple facts from astronomy, physics, chemistry and geology have a share in the subject matter of life-science.

Readings of paleontology place minute and lowest forms of life as the first to appear on the earth, and supply many superb chapters of the history of life. Truly biological consideration of selected types from virus and bacteria to man provides the background against which the principle of continuity, and of change dependent upon natural law, may be seen to reach from sun to man.

This most sketchy outline of a study capable of giving the student an *orientation toward nature* leaves unconsidered those numerous principles of biological science which relate to the student's own nature and which prepare him to live comprehendingly among other men. Of some of these many and specific things I wish now to speak.

Life-science can present the great fact of organic evolution. The origin by descent with modification of complex life including man himself, and the kinship of all living

things, are blended in this preëminent principle. The outlines of the rules and laws of that progress may and should become the common denominator of all thought about life. In the center of this great stream of life we discover the principle of progress deep within ourselves; and, as a crowning fact, we observe that of two million living species it is mankind that has been lifted most, and mankind that is now the moving point on the wave of life.

Life-science presents the broad and humanly momentous principles of inheritance: How and why the offspring find repeated in themselves the characteristics of their ancestors; knowledge and understanding of differences or variation among offspring; the utilization of these principles in the improvement of races of animals and plants upon which human existence depends; and finally, the full realization that on the basis of their heredity no two men are exactly equal. Indeed, the very mechanisms by which we begin life, and the inner hereditary forces which attend our growth and development, assure us that all men are unequally endowed by nature. So significant are these well-established principles, that we ask: For how long and to what extent dare communities, and their ever more complicated social and legal regulations, disregard the basic fact of the biologic *in*equalities of men? Here are questions for citizens to decide; and how shall just and satisfactory decisions be obtained and enforced unless at least a majority of citizens know the facts upon which the decisions are to be made?

Life-science now presents the inspiring facts of the plasticity or modifiability of the growing organism, even though initial hereditary inequalities can never be really erased. In much the same way, and using some of the same tools, by which life-science has obtained control over many diseases it has now made substantial beginnings in controlling the growth and attainments of plants, animals and of man himself. Depending upon which rays of light man selects to attend its growth the soybean can be made to become either a twining vine or a substantial plant; rats growing under all usual conditions may attain their usual size but, by adding much more of certain vitamins to their food-supply throughout the growth period, man can now make them grow to twice their usual size; on man himself—throughout the civilized world—those little human dwarfs known as cretins are having a cubit added to their stature, and new power added to their brains, by the use of a secretion taken from the thyroid glands of an ox or sheep. Best of all, these and hundreds of kindred things are things always repeatable under the prescribed conditions—they are in no way at the caprice of magic or of wishful thinking. What a world of wealth and inspiration is this to the unspoiled youth—the future citizen—who thus learns of man's fast-growing power over even his own destiny!

Life-science—thanks to laboratory triumphs for almost each one of the last twenty years—now presents a handful of vitamins with which any youth may cure certain diseases; and better still with these he can assure himself freedom from these diseases. This simply stated knowledge is needed by all, and all of it is particularly useful to the young. Shall we teach it in our schools? Or shall we leave it, like most other practical information about our natural environment, to the extra-curricular activities of chance membership in groups such as the Boy Scouts?

Life-science can give acquaintance with our own bodies and with the functions of our various organs. With interest in, and familiarity with, our own bodies and minds each individual would thereafter become the quite special and unique protector of his health and well-being in situations that attend all the days of his life. It is not negligible that this knowledge would curtail the quacks. Of inestimable importance is the circumstance that, if all our secondary-school graduates obtained the thorough

grounding in all aspects of life-science contemplated here, the public press of the country of two decades hence would become real adjuncts to the continuing education of our people in science. That service is nearly negligible now, because so few of our people have a basis for understanding any fine discovery that may be made about our intimate selves.

Life-science provides the natural and best opportunity of introducing those facts concerning reproduction and sex which are necessary for youth at or before the high-school age. We all know that many parents do not supply this expedient information, and that the personal welfare of many is adversely affected by a protracted ignorance of this somewhat difficult and delicate subject.

Life-science presents the ever-present and pervasive fact of the struggle for existence with the consequent elimination of the unfit. The young citizen will learn that in our civilized communities the harsher aspects of that struggle are not present; that the individual no longer depends on his perfect bodily fitness, on the acuity of his senses, on the alertness of his mind, to survive and reproduce. He will know that this must have profound effects upon the future of man. He will find much food for fruitful thought in the dilemma that, unless we develop and use a quite possible and far-reaching control over human reproduction and development, our high civilization will itself lead to the deterioration of the race; and, that this retrogression, already in evidence, renders the individual correspondingly more and more dependent upon the community for his welfare.

Life-science attends and discloses the halting steps of primitive man. That man required an unknown amount of time for learning to make a most simple tool—a flint for aid in obtaining food and subduing wild animals. But it is clear that for hundreds of thousands of years thereafter that paleolithic man made little or no further progress, and probably he built his first city only during the last 15,000 or 20,000 years. That long drab epoch of human futility provides a full and brutal demonstration of primal limitations of raw untutored man. And no citizen unaware of the lame march of early man, and the lifting power of a few tools and discoveries, has even begun to comprehend the human species.

Life-science shows that the drama of life was performed in a very restricted zone, quite near to the very surface of our small planet. Even bacteria disappear in the upper reaches of the atmosphere, and other life extends downward only to the limits set by the ocean depths. At no earlier time in the earth's history has this been different. Fossil remains of living things are found in coal and rock strata now some thousands of feet beneath the soil on which we walk, but it is clear that these veins were land surfaces or ocean floors when they trapped the dead bodies of organisms. If we could look at the present living world from afar, say from the 24,000 miles which is one-tenth of the distance to the moon, we could rightly sense the narrow pinions of life; on the great sphere which would nearly fill our view to east or west we should then see all life imprisoned in a thin film, a living skin, tightly fitted to the very surface of the earth. The entire story of life sticks to the place where there is liquid water, with earthy salts dissolved in it; where gaseous oxygen, carbon dioxide and nitrogen abound; and where surfaces can absorb sunlight for a continuous flow of free energy.

Life-science can emphasize the *newness* of intimate knowledge of ourselves. Nearly all of the definite and worth-while that we know about our own bodies has been learned within the time of men now alive. Most that we know about the care of our bodies and nearly everything that we know about fighting disease successfully has been learned in that same time or in an even shorter period. The whole range of diseases based on bacteria and viruses are things new to this period. The science of nutrition

is new. The science of anthropology is new. The real science of psychology is new. So it is with practically all other aspects of this subject. In the life-sciences the new evidence has come that life itself was evolved from the non-living; that one living species is slowly transmuted into others; and that all life phenomena from the division of a bacterium to the consciousness of man have evolved under natural law. As a result the intellectual life of some men of the present generation is a variety hitherto unshared with any former generation of man. It is the great educational opportunity of this day to bring this intellectual climate to the many who come for education to our secondary schools.

Citizens of today and of all tomorrows do and must deal with the question of the life of criminals. Will they decide on a basis of maudlin sentimentality or worse that society commits a crime, or that the individual juryman endangers his imagined future state, by extinguishing the life of an arch enemy of society? They will deal with the related question whether human hereditary rubbish will be permitted to flourish in a day when the creative power of man has removed the gruff struggle for existence —the struggle by which such rubbish was long suppressed and present man permitted to gain his basic physical and mental strength. They do and must deal with the question whether the sick may have the aid of what man has learned in the conquest of disease. They do and must deal, and not only the citizens of New York City, with the Father Divines who traffic in personal salvation. Citizenship everywhere, now and later, must deal with the question whether freedom to investigate and to state the results shall be preserved, for under our own eyes that freedom has disappeared from among a number of great peoples. Who will say that basic training in life-science is not our best reliance for a sane solution of these and similar problems? And who will doubt that future beehive aggregations of men may be wrecked if the ever-multiplied rules and laws under which they are forced to live are based upon variegated tradition instead of upon a common body of knowledge?

We have taken some pains to say that there is no lack of a body of knowledge especially adapted to real education at the high-school level; and that, fortunately, this same body of knowledge provides a firm basis for a comprehending citizenship. If there is failure to accomplish these most urgent things, that failure must rest primarily upon our educational leadership. Here again we acknowledge that, at present, conditions may force most of us to do less than his best.

With our better universities and research institutes largely dedicated to truth, but with practically all of our other institutions neglecting, twisting, curbing or suppressing basic biologic truth, there is little wonder that our people are uninformed or misinformed on man's own nature and man's place in nature. The corrective for this socially dangerous state of man must be sought in wide-spread adequate formal education at the level of the secondary school or earlier. There is no escape from the task of presenting man's superb scientific disclosures concerning himself to large bodies of our future citizens.

I submit the view that life-science merits study continuously throughout the four-year-high-school period, and that it is necessary alike to an acceptable education and to the most vital aspects of our social and national welfare. In this statement I think of life-science, and particularly its zoological aspects, not as an end, only as a *means;* but, because it supplies the background of man, because it is replete with the things intrinsically important to our own lives and personalities and because it carries the discipline of a solid science, life-science takes first place at the high-school age as a *means* of education. One finds that physics, chemistry and biology have all lost part or much of their position of thirty years ago in many secondary schools. Yet we all know that

the experimental method twinned with checked observation has been the main method of man's rise from barbarism to civilization; that it has been the method by which the awe-inspiring facts about the universe and man himself have been obtained. If our high schools cannot find opportunity to give familiarity and training in that method, if they cannot find opportunity to teach the nature of man and man's place in nature, just what kind of opportunity are they looking for?

B.—FOR SOCIAL SCIENCE*

Roy W. Hatch

Montclair State Teachers College, Montclair, N. J.

Dr. Riddle began with a personal statement. May I be pardoned if I do the same thing? I stand before you with my glasses in my hands. These are bifocals. I put them on and look through the lense so that I may get a wider view. I cannot read my paper this morning without my glasses. When I put them on, however, something has happened to me as I take out my paper to read it here to you. I am reading this paper to you now looking through the lense of a long lifetime of work in my particular field. I realize that that lense will color everything that I probably shall say to you. I think that is a scientific fact. I give it as a caution at the beginning of my paper. And I note that Dr. Riddle does not wear glasses.

Now, a second statement. Dr. Riddle spoke of his teaching experience. I have taught children all my teaching life. I teach them every day. I realize, therefore, that a theory that you may work out in the quiet of your study is one thing, and a theory that you put over in the school organization is another. I know that it is easier to teach twenty, yes, one hundred and twenty, what is good to be done, than to be one of that one hundred and twenty to follow my own teaching.

With those two personal statements, then, I proceed to the paper.

When Epicurus, the Greek Philosopher, was a lad of about twelve years of age, his teacher told him that the world was created out of Chaos. "Yes," replied Epicurus, "but who created Chaos?" "Only a philosopher," said his teacher, "can give you the answer to that." Right then and there Epicurus decided that he would be a philosopher.

I trust I shall not be too severely criticized at the start if I, like old Epicurus, use the philosophic rather than the scientific approach in my attempt to bring some form and semblance out of the chaos we now find ourselves in in the Curriculum of the Secondary School. For, to quote the words of one of your own great scientists, Professor Millikan, "Mankind's *fundamental beliefs* about the universe and his place in it must in the end motivate all his activities and all his conduct."

There are, as I see it, three schools of thought among our educational leaders in regard to "the universe and our place in it." Each school has its advocates and in the last few years we have been bombarded literally left and right with their respective points of view.

The champions of the most recent of these schools issue their challenge: "Dare the schools build a new social order?" These advocates make the assumption, first, that a vitally new and different social order is demanded for a new age, and, secondly, that there are certain indispensable characteristics that this new social order must possess. If we ask them for the basis on which they determine the criteria for their new social order they tell us that they deduce it from the writings from the "Frontier Thinkers" in the social field. If

* Read before the American Science Teachers' Association, Atlantic City, December, 1936.

we then inquire who are these "Frontier Thinkers," we are given a galaxy of outstanding names in the fields of sociology, economics, political science, ethics, philosophy and science. Should we then be so bold as to further inquire whether or not all these experts agree on what should constitute their new social order, there comes a somewhat awkward pause. Frequently we find these very "Frontier Thinkers" in radical disagreement with one another. All this leaves us somewhat dubious about any social order that is so uncertain as to its objectives and desirable outcomes.

If we now turn from the left to the right wing to see what the conservative school has to offer we get quite a different picture. This school feels that its job is to teach the established order, the status quo. Their function is not to determine the new and uncertain, but to maintain the old and tried. This group are followers. They conserve what their leaders in political and social action have already determined to be the course the people should follow. Theirs not to reason why; theirs but to maintain or die.

There is another school, however, that takes a middle ground between the conservative and the radical. It does so, however, from no spirit of compromise. It has no particular liking for compromise, for it has read history. It organizes its whole program and procedure around the central concept that as far as the "Universe is concerned and man's place in it," the one sure thing is change. No social order is static. This school takes its position in the present, looking back, to be sure, to a past that has taught it many a wise lesson, but also looking forward to a future, which, although uncertain and indefinite, is full of promise and confusion, of anxiety and hope. No generation liveth unto itself alone. We are all generations holding hands down the long avenue of time. But no generation can lay down the exact blueprint for the oncoming group and say: "These are the specifications which you must follow." For, I repeat, the one sure thing is change, and change today has on its seven-league boots. It is on this proposition and its ever-quickening corollary that I for one take my stand in building, not *the* New Social Order, but *a* New Social Order.

So much for philosophy. Now for pedagogy:—

Let us take a concrete approach. At Montclair we have a demonstration school, enrolling pupils for both the junior and the senior high school years. Every instructor in the college teaches also in the demonstration school, while his college students observe his teaching. It fell to my lot, this year, to teach a Ninth Grade, and my observers were the social studies majors from the college. On the very first day in September, I found on entering my Ninth Grade demonstration classroom only about twelve students, mostly girls, when I had expected to teach the entire group of 25, about evenly divided between girls and boys. I went at once to the Principal's office to find out the reason why I had only half a class, and the answer came back: "The other half of the class, mostly boys, have elected science." And there you have it! Here is a concrete case involving the topic before us today, namely: *The Relative Claims of Natural Science and of Social Studies in the Secondary School Curriculum.*

Now, when you have found the answer to this very particular and concrete case you will then have the answer of what an ideal set-up would be for both these subjects in our already crowded secondary curriculum. My own answer to this problem at first was not the right one. I'll even confess to a certain, or rather, not uncertain, indignation. What right had science to encroach on the social studies? But I felt, also, that the principal's answer was not correct, either; that the students could elect their own subject. And I had strong doubts about the attitude of the head of the Science Department, Professor Glenn, fearing that he was somewhat of a special pleader in

this connection. Who was right? Who should determine? And here the problem changes from the personal to the principle. What principles, what objectives shall determine this case? To state the proposition before us today in a truer light, is not the question: "What desirable outcomes as over against other desirable outcomes are the wisest guides to follow in building our secondary school curriculum?" In this light our topic for discussion here is too (two) limited. What right have we to assume that we are the Romulus and Remus to found a new social order on the Seven Pillars of Wisdom? What is, in truth, "the core?" Does it lie within the boundaries of any subject-matter field? Answer me this, and we have cleared away with one stroke the underbrush, so that we can see our problem in truer perspective. Was it the purpose of your program committee, I wonder, when they asked me to appear on this program, to expect from me as loud a bang and ballyhoo for the social studies program as I might well raise in this presence? Well, I trust that I shall not disappoint you too greatly even in that respect. And still the question persists. What is "the core?" Now, I do not dare to assume that I am the Moses to lead us forth from the desert of our curriculum confusion. But I would like to play the role of Aaron, and point out that our greatest leader in educational philosophy, John Dewey, has used an expression in his book *Democracy and Education* that I would like to submit as a possible guiding beacon through the sea of our difficulties. In speaking of the validity of certain subject-matter fields he writes: "It is their interdependence, that affords . . . the justification of their use in the curriculum. When one is divorced from the other, the information of either fails to develop into *living social experience.*" There, I submit, is your core. Life itself; "Living Social Experience."

Hitching our wagon to this core, where does it lead us? It leads us first and naturally, it seems to me, to a closer examination of the past. And what does that show us in this connection? And here I would like to quote what seems to me a rather profound observation, from one who has, at least, the detached viewpoint as essential in the social as in the science laboratory. The recently elected Director of the Institute of Education in England, Dr. Clark, observes:—

> "America has gotten along thus far with a kind of blind and merely organic expansion. Increasing population, newly discovered resources, and new processes of manufacturing have submerged rather than solved the problems of the past. You just grew. Your schools during that period were concerned with providing entrepreneurs and technicians. Now America faces the problems that cannot be solved by further expansion. Progress now is dependent upon better internal coordination. It reminds one of the point in biological evolution when the better integrated organisms began to win out over the great clumsy and stupid beasts. From now on your schools will have to be more concerned with studying social organization and social progress. The centre of emphasis in American life is shifting from the conquest of new areas to the better integration and coordination of what you already have. The social sciences will, therefore, have to be the center of your curriculum."

Naturally, I would not have quoted Dr. Clark at some length if I had not found myself considerably in agreement with him. When he concludes, however, with "The social sciences will, therefore, have to be the center of your curriculum," I, for one, and a social scientist at that, do not wish to take too narrow a view of the term "Social Sciences."

First, note the term "Social Sciences." We know all too well that the social studies are not scientific in their approach or analysis, as you would use the term. Yet today, surely, "living social experience" has its scientific implications and interpretation. Let us examine some of these implications. Pause with me for a moment to observe Rodin's famous statue "The Thinker." We note first the great bulk of this primitive ancestor of ours, bowed in thought, chin on hand, lost to the world about him. As we continue to gaze, we

catch a fellow feeling for this brute, and are ourselves stirred with a very intense recognition of his problem. The inert figure seems surcharged with strain. We find ourselves almost impelled to help him find his answer. What is he thinking about? "Yesterday, I killed him. I mashed in his head with my fist of stone. He did not move. He was dead. I dug a hole there, right there, and rolled him in. I put big rocks on top to hold him down. And yet, last night in the cave I saw him again. He spoke to me. I rose up to strike again. The fire was low. I could not find him. This morning I came back here. The stones have not been moved. He is there. And yet? And yet?" And down the years man still searches for the answer to his problem.

Rodin's "Thinker" is to me symbolic. It is man in the mass, trying to find answers for his perplexing problems. Life confronted him with these problems. He was to learn by the progress of trial and error. Life was the survival of the fittest. It was adaptation or annihilation. The stone-fist gave way to the spear. The spear gave way to the bow. He was confronted, as all his descendants have been from that day to this, with the problems of existence—food, shelter, clothing, and all the difficult adjustments he had to make with his mate, with his offspring, his neighbors, and the tribe beyond the mountain range. His social order was simple, and his children learned to follow in his footsteps. Those steps at first were halting and slow. There was little of change in these earlier periods of time in their "living experiences." Like father, like son. Then came science, that first upward thrust of a great naked arm to the skies—so strikingly and dramatically pictured by the artist, Orosco, in his famous murals in the library at Dartmouth College. And now, his pace quickens. Fire, the gift of the gods. Then, the hearth and domestication. The crude drawings on the walls of his cave. Pan, by the river. And then the symbol on reed and rock. And lastly, out of the very crystallization of his living social experiences comes the law, the common law bred by use and custom.

And so, down the long years he comes, ever trailing his problems behind him. To him there is no new social order just around the corner. Life is all corners. It grows in complexity. He has lost some of his old fears but he has gained new ones. He has found some answers, but many more perplexities. He walks into the present with many of his old problems unsolved and with many a new one demanding solution. Yet this modern is still very much of a primitive when you touch him deeply enough. Under his Hart, Schaffner and Marx is the skin of the savage. In the words of Anatole France: "We are already so old when we are born!" But the tempo of life has increased tremendously in the last century and a half, particularly, since the days of the industrial revolution. Professor James Harvey Robinson, in his epoch-making book, "The New History," says: "Man has changed more in his ways of living in the last 100 years than in all the previous centuries back to the Pyramids." This is a profound observation and the more it is considered, the greater grow its implications. It makes your task and mine one of serious import for we, as schoolmasters, must train the oncoming generation to meet and adjust itself to this rapidly changing social order. Your task and mine is to select from the past what has proved beneficial to the race, and "to hold to that which is good." But it is equally your task and mine to help this generation face its future, to guide its first stumbling steps, to go along with it for a part of the way, and then to let it alone. Emerson told us all this years ago: "It is not for you to say what he shall know or what he shall do. Respect the child. Be not too much his parent. Trespass not. He only holds the key to his own future."

We, as schoolmasters! Aye, there's the rub. We, as schoolmasters, look back with some longing perchance to the days of the

three R's, to simple subject matter, taught to all grades in the little red schoolhouse at the corner where the country roads met and crossed. But most of us have left the country and today more than half our people live in cities or in suburban districts where city conditions obtain. Much of this change has come about in our own transition generation. The city has complicated tremendously our whole sociology. We, who live in cities, are walking around its streets still wearing the old farm overalls of a rural sociology. In my boyhood I lived in a Cape Cod town of 1600 inhabitants. I knew most of them and their long-established family lines. They knew me and my family of one father and one mother and ten children. I cannot now recall a single case of a divorced father or mother in that country town. It just wasn't done. "What would the neighbors think?" was a deterrent stronger even than law itself. There was the old house that had harbored five generations of Hatches. There was the old kitchen with its roomy fireplace, warm abode of the old family Lares and Penates. I write these words in a large hotel in New York City. This hotel boasts more rooms than the total population of that old town. My desk on which I write is so near the closet that I have to close its lid before I can open the closet door. The living room changes places overnight with the bedroom. The kitchen is a concealed closet with two gas plates; and the janitor told me that by actual count there were more dogs than children in the hotel. Science has invented a dozen gadgets here and there about my apartment, where a pressure of the finger or a flick of the wrist brings me heat and light or a conversation with my publishers, while at arm's length from my desk I can reach out, stop all physical and mental effort and listen to "The Voice of Experience." And if I should count the married couples in this hotel, or those who say they are married, do you know what in the law of averages I should find in regard to divorce and companionate marriage? I think you do.

Where under city conditions has gone the effectiveness of "What would the neighbors think?" Who is Thy Neighbor in New York City? And I repeat, most of us are living today under city or suburban conditions. I've gone into some detail here just to show why the city is considered by many sociologists as our greatest social problem. Science has raised this great towering structure out of reinforced concrete and pressed steel. Science has estimated wind pressure and sway. Science has equipped these buildings with elevator service and fire escapes, wired them to gas and electricity and A. C. and D. C. radio sets. But the basic problem is not so much *how to erect* these great cliff-dwelling structures, but *how to direct* the lives of those who have to live in them. And this is a fundamental distinction.

And here I pause. I would remind you once more that our topic deals with the relative claims of natural science and the social studies. I do not feel, therefore, that it is germane for me to set up a specific program for the social studies in the secondary years. Moreover, it is far easier to claim than it is to realize on your claim. However, I have such a program for these years, organized and integrated, more or less, and I have put this program into operation at our demonstration school at Montclair. Consequently, I change it frequently. "Alas for the cripple, Practice, when he tries to keep up with the bird, Theory." (Emerson.) I am far from satisfied with my program but it has this one asset. It does not stand still long enough to have its picture taken. Since you, by placing me on this program, have impelled me to think through this problem still further—and for this I thank you—I am planning to make more changes.

Tuesday I addressed the New York principals, gathered in convention at Syracuse, on the subject: "The Teaching of the Social Studies." At this same meeting Dr. War-

ren W. Knox, State Supervisor of Natural Science for New York, also addressed the convention, proposing a twelve-year science course for New York State. He stated that it was his belief that "a twelve-year course in science is justified because of the basic importance of the field of science." I have tried to show you here today that there is something more basically important that science per se or history per se, or any other subject per se. Dr. Knox went on to say, however, and here I am with him almost 100%: "Encourage a broad integrated type of program in living social experience as opposed to the developing of a disjointed and unrelated series of isolated and unrelated units of subject matter."

Is it, I wonder, our primary job as teachers to insert into the curriculum a twelve-year course in science or a twelve-year course in the social studies, or a twelve-year course in English, or a twelve-year course in mathematics? Now you and I both know what the National Councils of all these subjects would answer in each and every case. And does not this very fact show forth something of its absurdity as a principle in curriculum building? Each subject twelve years, twice twelve hours in a day, one-half twelve hours in a school session, *but only one pupil.*

But with Dr. Knox's concluding statement I can agree without reservation for it breathes the true scientific spirits: "This program presents a plan of organization that has been tried out experimentally. Naturally, as we increase our knowledge about child psychology, and learn more about science teaching, revision and modification will be in order. It is only through cooperation, trial and research on the part of classroom teachers that we can hope to make progress."

"Cooperation, trial and research on the part of classroom teachers." This is the key that will, I believe, unlock the door of most of our difficulties. I am going to assume that Dr. Knox, although speaking directly for the science field, would be willing to broaden his statement to cover all of us who, as classroom teachers, are endeavoring to interpret *living social experience.* Holding to this concept we can re-echo the old words of the Mayflower compact, the finest definition of democracy ever penned in America:

> "In the name of God, Amen. We, whose names are underwritten do combine ourselves into a civill body politick for our better ordering and preservation. And we hereby resolve to make such just and equall lawes as shall be most meete and convenient *for ye generalle goode.*"

SCIENCE IN THE ROCHESTER SCHOOL OF THE AIR

HARRY A. CARPENTER
Specialist in Science, Rochester Public Schools, Rochester, New York

With the completion of this semester's work, January, 1937, the Rochester School of the Air will have been carrying on for four years. When inaugurated on February 7, 1933, the Rochester School of the Air offered the following courses:

Lessons in Social Studies by Charles E. Finch, Director of Junior-high-school Grades of Rochester.

Geography Talks by Mark Ewald, Staff of WHAM.

Science Lessons for Seventh Grades by Harry A. Carpenter, Specialist in Science for the Rochester Schools.

Twenty-five schools, six of which were outside of the city of Rochester, were enrolled as members at the start of the Rochester School of the Air. Today all of the elementary and high schools of Rochester and approximately a hundred and ten schools outside of Rochester are enrolled for one or more of the following courses:

Course	*Times per week*	*Broadcaster*
Social Relations—5th Grades	Bi-weekly	Lawrence C. Ross
History for 4th Grades, 8 weeks beginning Feb. 1937	Once	Rochester Museum of Arts and Sciences
Science for 4th Grades	Once	M. Elizabeth Tuttle
Science for 5th Grades	Once	Harry A. Carpenter
Science for 6th Grades	Twice	M. Elizabeth Tuttle
Science for 7th Grades	Twice	Harry A. Carpenter
Science and You for Grades 10, 11, and 12	Bi-weekly	Harry A. Carpenter
Elementary-School Concerts	Bi-weekly	Civic Orchestra
High-School Concerts	Bi-weekly	Civic Orchestra
Books for 5th Grades	Bi-weekly	Public Library
Library Talks—English and You for Grades 10 and 11	Once	Public Library
Affairs from Afar	Once	Jacob S. Ross
Guidance	Once	Frances Stewart
Art Appreciation	Once	Mrs. Elizabeth Cross
Let's Sing for 2nd Grades, 6 weeks beginning Jan. 1937	Once	Maxine Broughton

The science enrollment of eleven hundred pupils in February, 1933, has increased to over 22,000 individual students at the present time. Altogether the different radio classes in the various offerings indicated above have a total enrollment of 55,000, of which nearly 35,000 are within the city of Rochester, and approximately 22,000 outside of Rochester. These figures, of course, do not include the thousands of adult listeners, many of whom are learning about the science of their environment for the first time.

For the semester ending January, 1937, about fifty Rochester schools and more than 110 schools outside of Rochester regularly make use of the science and other subject broadcasts of the Rochester School of the Air. The area served is some 250 miles northeast and southwest by 150 miles north and south, including several schools in Canada.

Preceding the opening of the Rochester School of the Air* some broadcasting in science, mathematics, and English had been done during summer vacations, under the general direction of Miss A. Laura McGregor, Director of Educational Research for the Board of Education. Much of the success of this new adventure is credited to Miss McGregor. However, with the in-

* An account of the early work of the Rochester School of the Air, including a discussion of the method used in broadcasting for seventh grade science was published in Junior-Senior Clearing House, March, 1934.

crease in offerings, Mr. Paul C. Reed, new Supervisor of Radio and Visual Education, is in general charge of the programs. Starting with three broadcasters, the Rochester School of the Air now includes ten teachers on its staff who devote part of their time to broadcasting.

This brief introduction is presented to show the rapidity with which the Rochester School of the Air has grown. At the beginning schools participated on a voluntary basis, and purchased radio receiving equipment from their own funds. Stromberg-Carlson Station WHAM and the Gannett Station WHEC donate the time. Hence, for two semesters the project was carried on without extra cost to the Board of Education. While the initial project had the approval of the Board of Education, it was not until interest in the offerings and results based on certain concrete evidence indicated success, that the Board of Education financially endorsed the project, with the result that now all elementary schools and high schools are equipped to receive radio programs in various classrooms. Moreover, the radio offerings have become an established routine of the elementary grades and the senior high schools.

Since this article is designed particularly to describe the science radio work, further reference to the other important work of the Rochester School of the Air will necessarily be omitted in the interest of brevity.

At present we are broadcasting separate lessons in science for fourth, fifth, sixth, and seventh grades, and for senior-high-school science classes.

For twenty-two years science has been a required part of the curriculum of our junior-high-school grades. However, when seating capacities of the junior high schools necessitated holding many of the seventh grades back in the grammar schools, the science work appeared most likely to suffer because of lack of equipment and trained science teachers in the elementary schools. It was at this dilemma that WHAM offered its facilities and the writer was given the opportunity to try the experiment of teaching science by radio.

At first thought it seemed inadvisable to attempt science instruction by radio, this because of the writer's belief in the fundamental importance of pupil activity in all science work. Science by radio seemed the very antithesis of this objective. However, the experiment was started, with results which will be presented below.

The teaching of science by radio in the Rochester School of the Air has been unique in that we have followed our prescribed course of study used by teachers in the elementary and junior-high-school grades rather than simply to offer material of an inspirational or supplementary nature. This decision was reached because of the demonstrated value of systematic science work in the seventh grade, which involves textbook study, school and home experimentation, and field study and observation. It involves also the keeping by the pupils of a Science Discovery Notebook.

For three and a half years the seventh grade science broadcasts have been presented twice weekly for thirty minutes, each listening class continuing with follow-up work for twenty minutes after the broadcast. There are thirty to thirty-five lessons each semester. Each broadcast has been participated in by four or five pupils from a selected school with comments by the principal or teacher. More than, fifteen hundred girls and boys have thus taken part in the science broadcasts representing nearly every elementary school and several senior high schools in the city and many out of town schools.

On one occasion the engineers of WHAM installed a portable, short-wave broadcasting set in the classroom of an elementary school so that pupils took part in the program from their classroom, the broadcaster being at the studio. On another occasion, the set was installed in a one-room district school outside of Rochester. The radio teacher conducted the

lesson from the studio, during which Rochester pupils in the studio, and pupils in the district school, participated, discussing with each other problems raised by the broadcaster.

When the eighth grade work was added, it was offered for two thirty-minute periods with twenty minutes follow-up work by the teacher. With the addition of fourth, fifth, and sixth grade broadcasts, the time for all broadcasts has been cut to fifteen minutes, with thirty-five minutes for follow-up work. As a result of this change, pupils participate in the broadcasts at the end of each unit of study.

Some seventh grade pupils and most eighth grade pupils have been housed in junior high schools where science instruction is given by trained science teachers and where adequate equipment is available. Hence, it has seemed desirable to give the same term-end examinations to both groups of seventh and eighth grade pupils. The examinations in every case have been written by a committee of science teachers from the junior high schools. Below are given some results of those examinations. Because of the lack of space only scores of the middle group, number tested, and medians are given. However, these data are sufficient to indicate that as far as examination results go, pupils taught by radio do as well, if not a little better than those taught by the traditional method. The science examinations included the following types of questions: completion, multiple choice, true-false with reason, identification of cause and effect, fact and theory with evidence, and questions relating to required laboratory work.

Significant as examination results are, they are not sufficient evidence on which to base any conclusion as to the success or failure of science teaching by radio. It is necessary to obtain in addition evidence indicating pupil interest, pupil activity, and evidence as to whether or not the teaching is resulting in the development of desirable changes in attitudes, understanding and use of the scientific method, and the extent to which pupils are being advanced in their ability to do scientific thinking.

Each class in radio science is organized as a Department of Science with Chief of Staff, Chief Observer with assistants for weather, astronomy, birds, trees, *etcetera*, a Chief Health Officer, a Chief of Scientific Methods, and a Chief of Records. In this organization the teacher is the Director of the Department. The Chief of Records and other officers report to the broadcaster on all work of the class, including experiments performed at school and at home and other activities. Results of class deliberation with respect to problems raised by the broadcaster are also reported. Unit tests are given and corrected over the air. Results of these tests are sent to the broadcaster.

Below are a few quotations from reports from pupils. It is expected that the reader will make his own interpretation of these results. Space does not permit an adequate sampling of reports.

RESULTS FROM EXAMINATIONS

Examination Results for:	*Radio Science Group*			*Junior-High Science Group*		
	Middle 60% Score	*No. Tested*	*Median*	*Middle 60% Score*	*No. Tested*	*Median*
June 1933*–7B ..	51–37	612	45	47–31	498	40
Jan. 1934 –7B ..	54–37	2138	45	48–33	406	40
Jan. 1934 –7A ..	69–54	588	63	69–50	837	60
June 1934 –7A ..	87–70	1569	80	84–64	1103	75
June 1935 –8A ..	.....	332	78	.....	2205	74

*The results for June 1933 were originally reported in the Junior-Senior High School Clearing House, March 1934. Other data not previously reported.

School 22—"Nineteen pupils have tried the experiment with a pan of water. They found that the piece of wood did not reach the side of the pan. This proves that the water does not move from the center outward." (Note: This refers to a study of water wave motion.)

School 1—"Thirty-two children have done the candle experiment at home. Twenty-nine have done the sorting of soil into layers experiment at home. We also did it in school."

School 24—"We have been trying an experiment with some of our rocks. We have taken soft rocks and rubbed them with hard rocks, forming soil. It is very slow work but lots of fun. We have made several tablespoonfuls. We are going to make enough to try planting seeds in it. We wonder if seeds will grow in rock or must it have some humus."

School 23—"During my vacation I performed an experiment of my own to see how the glacier was formed. I took a handful of feathery snow and packed it down hard. Finally, I had quite a mass of snow packed together. This is how I think the glacier was formed, except it was not packed down by human hands."

School 39—"We have tried all your experiments in school and most of them were performed at home. There is a table at the side of the room where we keep different things to perform the experiments. The Chief of Staff keeps everything recorded on a chart about different things that we do in science."

Ellis—"I like science as well as ever. Mother had me whitewash the coal bin and then she gave it to me as a laboratory because we had an oil burner put in. I got a chemistry set for Christmas."

Ralph—"Your lessons have inspired me to do much thinking. I have performed an original experiment to prove oxygen is necessary for combustion. I used the candle experiment to use up the oxygen in a large jar. A small jar was filled with water and inverted in the water. I tipped the large jar sideways and allowed the nitrogen which was left in it to escape into the small jar which I covered and took out of the water. A candle when lowered into the jar would not burn."

School 46—"I can say truthfully that I have gained many handfuls of advice in my last semester's work, which cleared my mind of many burdens. These are some of the points: To ask more questions when I don't understand words or facts about science; to give my opinion in science class; not to leap before I look in experiments."

School 46—"I wish to tell you how much your programs have helped me in my study of science. I have heard almost all of them. Even when I am sick in bed my mother lets me listen to it. There are a couple of questions that I would like to ask you. They are: What makes wind whistle? What are microbes? Are they anything like bacteria? Are they harmful? I would be very appreciative if you could write and tell me the answers."

Seneca School—"If certain plants take up more minerals than others, why could not scientists adapt this to help in locating minerals such as nitrates or any other plant food? You mentioned that a certain plant takes up more nitrogen than any other plant. If this is true, maybe this would help in discovering nitrate in the soil."

School 18—"I wish to thank you very much for answering my letter about people living on other planets. It has made clear in my mind that it is impossible for people to live on the moon and the sun. It not only taught me this but taught my class and myself many other lessons. From now on I will be more careful about what I hear."

School 26—"I told my mother and father about cleaning up things in the attic and under the stairways. I cleaned up my bedroom and threw away all the loose papers and rags. My father said he would clean up the attic when he had time. My father is taking the paper off the walls and repapering."

Through the study of science, pupils should have training not only in the inductive way of thinking, but in the deductive method, because, after all, the consumer is not a researcher but is one who meets problems, the solution of which depends upon his knowledge of fundamental principles and his ability to apply the principle to a specific case. The following indicate the type of questions which children try to answer by applying some of the principles they have learned in science:

What makes spring water cold?

On a sunny day when the air temperature is below freezing, why does ice melt in the streets?

Why does warm air make us sleepy?

If air is inhaled in your breath and oxygen is used up and carbon dioxide is given out in the breath, what happens to the nitrogen?

Is it true that because Indians walked on the balls of their feet they did not have arch trouble?

If a fire needs oxygen for burning, why is it when you blow on a stick with sparks on it, it starts a fire, if you exhale carbon dioxide?

Is it capillary action or pressure that makes spring water come to the surface of the earth?

The question relating to the Indians was discussed over the radio for the purpose of pointing out the danger of making a wrong assumption in their questions. In

this case, for example, there appears to be no evidence that Indians walked on the balls of their feet, as is so frequently believed. Questions of all kinds sent in by pupils are discussed in this manner over the radio or by direct correspondence with the grade raising the question.

Two years ago under the direction of the writer, a series of fifteen lessons in high-school chemistry and fifteen lessons in high-school physics were broadcast over WHAM by various high-school teachers, inaugurating the Rochester Evening School of the Air. While results of these efforts appeared to warrant the continuation of the project, both from the viewpoint of the schools and the station, however, commercial commitments of the station for evening time and the availability of suitable science teachers willing and able to contribute their time and energy in addition to an already overloaded daytime teaching schedule, prevented the continuation of the project. In the writer's opinion, an evening high school of the air with credits toward high-school graduation is a fertile opportunity.

CONCLUSION

Teaching science or any other school subject by radio, has, in my opinion, some advantages over the traditional method for certain grade levels; namely, the lessons are developed with greater care than would be possible for an individual teacher who is meeting five classes daily, with a total of two hundred to three hundred fifty individual pupils. Moreover, if the lessons are presented by an experienced teacher, they should serve as models of good teaching procedure. Second, the classroom teacher is relieved from routine lesson preparation, lesson presentation, the writing and giving of tests, and is able, therefore, to devote greater attention to individual pupils in her class. Third, parents listening in become familiar with the course of study, its content, method of presentation by the teacher, and objective sought. Thus the parent is able to discuss the work understandingly with the child and so help in promoting his education. That many parents listen in and do appreciate this clearer insight into the teaching of their children is evidenced by many written and verbal reports. For the first time in the history of education, parents, teachers, and pupils may effectively unite in a common purpose—the education of the children.

Radio instruction in science provides for better ear training which is sometimes neglected because of the wealth of beautiful books, pictures, motion pictures, and visual aids.

Through radio small schools in the country may have the benefits of the more highly trained and experienced teachers of the city.

The training of teachers in service offered by radio instruction is a most important outcome.

That there are some disadvantages or handicaps resulting from the use of radio in education is, of course, true. However, in certain subjects and at certain grade levels the advantages are such as to warrant more extensive experimentation and study of the use of radio in connection with school work. This is especially true of curriculum teaching as compared with supplementary work. It seems important in every case to maintain a classroom situation, as far as possible. It seems important also to provide methods of contact between the radio teacher and the pupils in the classroom by letter correspondence, by pupil participation in the program, and by visits of the broadcaster to the schools.

THE NEED FOR A NATIONAL PUBLICATION FOR SCIENCE TEACHERS*

EARL R. GLENN

New Jersey State Teachers College at Montclair

In accepting the invitation of the Vice-President of the American Science Teachers' Association to discuss this topic today, we do so with a full realization of the complexity of the problem facing us and of the fact that we have no proposals of any great merit to suggest.

As a matter of fact the title may be somewhat misleading. There are now several active journals of great value to science teachers that have been rendering service over a long period of years. We need only to mention such magazines as *School Science and Mathematics, Science Education,* and the *Journal of Chemical Education.* To a lesser degree, in years of service, we should add to this list, the *American Physics Teacher,* the *Science Leaflet, Current Science Magazine,* and the *N. C. E. S. News Notes,* a publication of the National Council on Elementary Science.

This list is not at all complete since there are certain publications of museums, state associations, and local associations, with a limited circulation among science teachers, that we will not be able to discuss today. With one exception, perhaps, we propose to deal only with those magazines that publish articles bearing upon the problems of science education in public or private schools at either the elementary or secondary levels. We include the training of prospective teachers in this discussion, both science teachers and non-science teachers, because the time is at hand when every teacher is in urgent need of basic training in science as a matter of general education. We will be unable to discuss the technical journals.

Several of the publications mentioned could justly claim to be national if not international in character. If, then, we have important journals in the field of science education and some of these are national if not international in distribution, why should we be discussing "The Need for a National Publication for Science Teachers"?

Our problem may become more specific if we try to answer this question: What educational magazine in the field of science should a teacher receive in order to keep up with present-day developments in science teaching? Of course, if a teacher deals with just a single subject, as chemistry, the answer might appear quite obvious. However, there are very few who teach a single science subject and the demands for a wider professional interest in various fields of science are increasing in many important respects.

There is a growing demand also for science teachers with a real knowledge of the needs of science education at all levels of school work. The problem of a satisfactory educational journal for a teacher of a single science subject is no longer the simple matter that it once might have been.

The problem that we have before us does not grow out of the lack of excellent journals in the field of science education. It does not grow out of the lack of wide geographical distribution of these journals. One cannot examine the thirty-six volumes of *School Science and Mathematics;* the twenty volumes of the *General Science Quarterly* and *Science Education;* the thirteen volumes of the *Journal of Chemical Education,* without reaching the conclusion that we have produced here in the United States of America the most extensive body of literature dealing with problems of science education to be found any place in the world. In these pages will be found invaluable assistance for any teacher, any department head, any principal, any superin-

* Read at the meeting of The American Science Teachers' Association, affiliated with the A. A. A. S., December 31, 1936, at Atlantic City, N. J.

tendent, any board member, or any parent. Local and state committees as well as curriculum experts will find great aids for their work in these records.

We should like to see this association develop a future meeting devoted to the adequate appraisal and appreciation of the great services rendered to education by the editorial organizations that have brought the magazines mentioned above through the world's worst economic depression. Any science teacher who will read these journals year by year and try to improve his own teaching will almost certainly receive adequate professional and financial returns for his investment of time and money.

But the typical science teacher does not read these magazines—any of them! He does not know, apparently, that such professional aids exist. We may say the same for his principal and superintendent. Dr. Meister, in a report prepared for the Science Association of the Middle States, estimated that there are at least 10,000 science teachers in New York, New Jersey, Delaware, Pennsylvania, Maryland, and the District of Columbia. We should be surprised if 500 of these teachers are now on the subscription lists of any of the journals in the field of science education.

Now, what are this and other professional organizations going to do to correct this very unsatisfactory situation? If prosperity may be said to be just around the corner we may have hope and courage to deal with this problem.

We must study the reasons offered by the rank and file of science teachers for failure to use the recognized professional aids for growth in service. Some will say, "We should raise salaries so teachers can buy needed professional aids." It is my personal opinion that if the salaries of these 10,000 teachers were doubled as of January 4, 1937, there would be almost no increase in the subscriptions to our major journals. Others will say, "We should make the magazines more attractive to science teachers." It is difficult to see how marked changes of editorial policy will bring the wandering teachers into the fold of professional knowledge and competence. Still others will say, "We should work out a plan of national cooperation between local science organizations and the editorial boards of magazines." We believe this suggestion has great merit but we do not believe such plans will ever succeed until there is a person to spend most of his time going from state to state to keep alive the contacts with local groups.

Others may say, "Reduce the cost of journals so the science teacher can afford them." In my opinion this is probably impossible as conditions now exist. In fact, editorial boards have never received any just financial returns for their labors. We hope society will find a way to reward these public servants adequately in the future. Hardly a dollar of trust funds, research funds, or awards for public service has gone into the publishing of such magazines as *School Science and Mathematics, General Science Quarterly,* or *Science Education.* This educational service has come, almost entirely, from the personal funds and labors of a very small group of professionally-minded science teachers and manufacturers of scientific apparatus and books who have carried these burdens for over thirty-five years. We need a new deal now so that science teachers generally—or society—or both—will share these expenditures of time and money.

A small group of courageous individuals may say, "Combine all of the journals in science-education fields; reduce the overlapping of functions; build up a large national circulation through local organizations; increase the frequency of publication; and reduce the annual cost of subscriptions to the individual science teacher." Those who make such a suggestion probably have no real appreciation of the practical difficulties involved in such a proposal. Ideal as this plan may be, it probably could never be realized without (1) a rather large sum of money to make the merger possible,

and (2) the provision for a full-time editor and business manager. However, many science teachers believe that some public benefactor could render a great service to science teaching in particular and to education in general by making possible such a merger. With such a consolidation a carefully thought out set of plans would have to be put into operation over a period of years to get science teachers into the habit of using such an important professional tool for public service. The full-time services of at least two able science teachers would be necessary to execute such plans.

With this review of some of the difficulties presented to the science teacher by a multiple list of magazines, let us consider a specific case of a young teacher who is well-trained and ambitious to grow in professional competence as rapidly as possible. What journal or journals should such a teacher receive? For the present we will not consider library copies because such copies have limited uses for any particular teacher in classroom work.

We may assume that this teacher will be fortunate if funds can be spared for the purchase of (1) an important magazine in the field of general education; (2) a scientific magazine which surveys the major discoveries in various fields of science; (3) a professional journal dealing with problems of science education. If we suggest *School and Society* for the field of general education; the *Science News Letter* for surveys of scientific work, and *Science Education* for the professional interests of a science teacher the annual expenditure for these publications would be twelve dollars. By special arrangements it might be possible to reduce this sum to about ten dollars. Few science teachers now look upon such an expense as advisable or necessary.

The annual salary of all teachers in this state is now slightly above eighteen hundred dollars. To be sure, the annual salary of high-school teachers is much higher but science teachers begin work at salaries varying from twelve hundred to eighteen hundred dollars. Thus it happens that at the time a young teacher is most in need of these scientific and educational journals his salary is at the lowest point of his career. Perhaps this habit of neglecting important magazines is formed during these early years of service and tends to persist throughout life.

As a summary of this paper we may say:

1. Science education is now facing one of the most important periods of change in its history in this country. These changes originate in profound changes in society, in science, and in educational practices.

2. Most science teachers are unable or unwilling to attend local or national professional meetings of scientific workers.

3. If these teachers, who stand between the layman and his knowledge of science and the research workers in science, are to be kept in touch with scientific developments and their use in education some means will have to be found to place important publications in their hands, at frequent intervals, and, at a reasonable cost. No single organization seems now to be in a position to do this. The cooperation of several professional groups will be necessary to achieve this important goal.

4. The need for a singe national journal to replace the many existing local magazines is now greater, perhaps, than ever before in the history of science education in this country.

5. Institutions that train science teachers should encourage these young men and women to secure and use diligently the important journals that will insure growth in professional competence. Superintendents and principals should put a much greater premium upon such active public service than is now true in most school systems.

Discussion of Mr. Glenn's paper

By CHARLES J. PIEPER
New York University

I wish to make one point clear at the outset of this discussion. When the secretary asked me to discuss Mr. Glenn's paper, I wrote him stating that I should be glad to participate from a professional point of view but not from the point of view of an editor of an existing journal.

The enthusiasm which Mr. Glenn exhibits about a national journal of science education takes me back some eight years when *General Science Quarterly* became *Science Education*. I should like publicly to express our appreciation for this same enthusiasm which he then exhibited and which aided so materially in establishing *Science Education* in its new form. That is not complimenting the journal but rather complimenting the man who helped to make possible the forward movement.

I did not have the privilege of reading Mr. Glenn's paper. What I have to say was prepared in anticipation of what he might say. There isn't a total correspondence between what I thought he might say and what he said. Although he does express consoling words about the practical value of *Science Education*, it lacks much of being the solution to the demand for a national magazine. I can take little consolation, little feeling of satisfaction, out of his commendations because I feel that any magazine if made attractive and worthwhile could do the things which he has suggested it can do and do it on a firm financial basis.

I think Mr. Glenn has stated, throughout his paper, the major premise for my discussion. The premise is in two parts. First, if the existing magazines do not serve all of the various purposes which should be served by them, then there is need either for a better and bigger journal, or there is need for improvement in the existing journals. Second, if the existing magazines fail to serve adequately these various purposes which they can serve, then, too, the same results are indicated.

I start with very strong convictions that the magazines in the field have attempted to serve most of the purposes which should be served by a national magazine, but that, for one reason or another, they have not served those purposes adequately.

I should like to enumerate what I think are the fundamental purposes, which the existing magazines, in a combined way, or which a single national magazine should serve. First, the purpose of assisting administrators, supervisors, and teachers of science at all levels to integrate for themselves a philosophy of science education in harmony with a defensible philosophy of general or professional education and adequate for the particular level of institutional work in which the philosophy of science education is being put into effect. This statement of purpose includes not only science teachers but also supervisors and administrators. It is in the direction of this purpose that we have done too little to stimulate the enthusiasm for science teaching on the part of administrators particularly. We ourselves wax enthusiastic, as we have done today, but the magazines, as far as I have followed them, have not brought the message over to the administrators in any serious way.

Second, the purpose of providing for administrators, supervisors and teachers of science activities acquaintance with and critical consideration of progressive and challenging movements in the field of science education. This relates to courses of study, syllabi, textbooks and accompanying manuals, and points of new interest regarding the content of the curriculum side of our science work.

Third, the purpose of giving critical consideration to the techniques of instruction used by successful teachers and supervisors, both the general techniques and the more specific classroom techniques. I am thinking about the general consideration of techniques based upon the psychology of learning, and also about how to do this par-

ticular thing, this particular demonstration, or this particular project, and so on through the great list of types of physical and mental activities which brings science to the learner where science really functions.

Fourth, the purpose of acquainting those interested in science education with available and promising instructional materials, such as books and manuals, workbooks, pamphlets, magazines, exhibit materials, laboratory and demonstrational equipment and supplies, visual and auditory aids, test materials—all of those instructional materials for which a magazine of the right type may serve as a substitute for visitation. Those of us who have had the opportunity to visit know how much we learned as we went about seeing how this teacher does this and how that teacher does that in the classroom. That particular kind of material has not been brought forward in the science educational journals in anything like adequate form.

Fifth, the purpose of bringing to the attention of all connected with science education in instructional, supervisory, and administrative capacities the researches in the field, as well as the problems needing research. The latter phase is added upon the basis of the thought that the classroom teacher needs to know much more of the research which is going on and needs to be led and inspired to do more of it in the classroom. There, again, I think our journals, as I have studied them, have been particularly weak.

Sixth, the function of presenting to supervisors and teachers of science newer developments in pure and applied science and suggesting sources for further study of these discoveries and scientific applications.

May I interject one statement here. We have never included in the journals, as far as I know, what appears annually in *Science* and *Science News Letter,* namely, advances in the field of science during the current year. I think I know the reason why we haven't. I think the reason has been that those of us who are interested in the journals see *Science* and *Science News Letter* and therefore feel that everyone else sees them. But, if there are 18,000 high schools in this country—if I might join the prediction of experts on this program today and say that on the average there are two or three science teachers in each of those schools—we have there a large number of science teachers who, I am quite sure, as was Mr. Glenn, never see the scientific journals and therefore fail to be acquainted with many of these new advances in science.

Seventh, the purpose of bringing to the attention of pre-service teachers the standards and requirements for professional service in the field of science teaching.

Eighth, the purpose of acquainting American teachers, supervisors and administrators of science with plans and programs and policies of science education in foreign countries. There are a large number of interesting movements going on in foreign countries. We tried in the early days to have on *Science Education* a group of foreign editors. We did get some reports of plans and activities in certain foreign countries. We have not done justice to the kind of things that have developed. Mr. Glenn gave one reason which I do not state as an alibi but as a good reason. Time is too much taken with other activities to follow all of the possible leads. There have been in the last six years six important documents on science education published in England. Not one of them has had mention in *Science Education* during that time. I am willing to indicate the faults of the journal in order to indicate the possibilities of the journal.

And may I give as the ninth and last major purpose one which is dear to all of us, that is giving science a better standing as a means to general education in the modern general education curriculum.

Now, I would like next to call attention to certain criteria which I think should be

borne in mind when considering the materials which should go into a journal that serves the purposes indicated.

The first criterion, and by far the most important to me, is this: The materials should be truly representative of all challenging points of view and movements in all parts of the country. Negatively stated, the material should not be dominated by any one philosophy or point of view of science education of a small group of a single institution or of a single individual; it should be truly a forum of points of view. We have no journal in my own judgment which is adequately a truly representative journal from the point of view of this criterion.

The second criterion follows upon earlier discussions today and is a basic one. It is that all levels of science work concerned with general and cultural education shall be considered including, for example, the preschool, the primary grades, the intermediate grades, the junior high school, the high school, the junior college, the professional school which trains teachers for these activities, and science in adult education.

The third criterion is this: Material shall provide a balanced diet with respect to philosophy of science education, psychology of learning in science, research in the field of science, techniques of instruction, and materials of instruction. Not in one issue, which is utterly impossible, but over a range of issues. I think we could draw our analogy for a balanced diet from our point of view of a balanced diet in nutrition. It isn't necessary to balance our diet at each meal, and if it were, none of you would do it anyhow.

The fourth criterion: Material shall be worthy of the spirit of science. If it is a research paper, it should be tested research. If it is a philosophical paper, it should involve cogent reasoning, imagination, and those other characteristics of that which is good philosophical thinking. Whatever it is, I say again, it must be written in the spirit of science and open-minded above everything else.

RESEARCH STUDIES RELATING TO THE TEACHING OF SCIENCE

Charles J. Pieper
New York University

The present bibliography is a supplement to the previous lists which have appeared in this journal, and covers the period from January, 1934, through December, 1936, inclusive. The arrangement of the bibliography follows the general plan used in the earlier compilation of titles, and presented in outline in the October, 1931, issue of the journal. It should be understood that the arrangement is an arbitrary one, prepared for use in the compiler's course entitled "Investigations in the Teaching of Science."

It was thought worth while to present in Sections A, B, and C of the bibliography certain general references which have been found to be of value to those interested in research in this field. However, it should be clear that no attempt has been made to list there the numerous books, monographs and articles, published during the period, and related to the problems of educational research in general.

The reader will observe that some studies under section D are not specific to the field of science education. All studies, however, are related to the teaching of science and throw direct light on the problems of science teaching.

A. References Containing Bibliographies, Digests and Abstracts

Beauchamp, W. L. "Selected References on Secondary School Instruction: Science." *The School Review* 43: 140–142; February, 1935.

———. "Selected References on Secondary School Instruction: Science." *The School Review* 44: 139–141; February, 1936.

Colorado, University of. *Abstracts of Theses for Higher Degrees, 1934.* University of Colorado Bulletin, Vol. 34, No. 14. General Series, No. 350. University of Colorado Studies, Vol. 22, No. 1. Boulder, Colorado: University of Colorado, 1934. 78 p.

———. *Abstracts of Theses and Reports for Higher Degrees.* University of Colorado Bulletin, Vol. 35, No. 15. General Series, No. 367. University of Colorado Studies, Vol. 23, No. 1. Boulder, Colorado: University of Colorado, 1935. 80 p.

Eby, Frederick, and Frost, S. E., Jr. *Graduate Theses and Dissertations Written in the Field of Education at Baylor University, Southern Methodist University, Texas Christian University, Texas Technological College, The University of Texas, West Texas State Teachers College, with Instruction to Candidates for the Degree of Master of Arts, Doctor of Philosophy in Regard to the Form to be Used for the Thesis.* Austin, Texas: University of Texas, 1934. 77 p.

Gilchrist, D. B. (Editor). *Doctoral Dissertations Accepted by American Universities, 1933–1934.* No. 1. New York: The H. W. Wilson Company, 1934. 98 p.

———. *Doctoral Dissertations Accepted by American Universities, 1933–1934.* No. 2. New York: The H. W. Wilson Company, 1934. 98 p.

———. *Doctoral Dissertations Accepted by American Universities, 1935–1936.* No. 3. New York: The H. W. Wilson Company, 1936. 102 p.

Good, C. V. "Doctor's Theses Under Way in Education, 1933–1934." *Journal of Educational Research* 27: 380–400; January, 1934.

———. "Selected Bibliography on the Methodology of Educational Research and Related Problems, 1934–1935." *Journal of Educational Research* 29: 156–170; October, 1935.

———. "Doctor's Theses Under Way in Education, 1935–1936." *Journal of Educational Research* 29: 384–406; January, 1936.

———. "Selected Bibliography on the Methodology of Educational Research and Related Problems." *Journal of Educational Research* 30: 60–76; September, 1936.

Indiana State Teachers College. "Abstracts of Unpublished Masters' Theses, Indiana State Teachers College, 1933 and 1934." *The Teachers College Journal* (Terre Haute, Indiana) 5: 217–264; July, 1934.

———. "Abstracts of Unpublished Masters' Theses, Indiana State Teachers College, 1934 and 1935." *The Teachers College Journal* (Terre Haute, Indiana) 6: 181–196; July, 1935.

———. "Abstracts of Unpublished Masters' Theses, Indiana State Teachers College, 1936." *The Teachers College Journal* (Terre Haute, Indiana) 7: 105–135; July, 1936.

Indiana University. *Abstracts of Theses and Dissertations in Education at Indiana University Approved in June and October, 1932 and 1933, and List of Theses and Dissertations in Education at Indiana University from 1910 to 1933.* Bulletin 7. Bloomington, Indiana: Alpha Chapter of Phi Delta Kappa, Indiana University, 1934. 64 p.

Iowa, University of. *Graduate Theses, Including Schedule of Dissertations of Approved Candidates for Advanced Degrees with Major and Minor Subjects.* University of Iowa Studies, new series, No. 293. Series on aims and progress of research, No. 47. Iowa City: University of Iowa. Official Statement from the Office of the Dean of the Graduate College, February 1, 1935. 59 p.

McSPADDEN, W. W. "Selected References on Elementary School Instruction: Science." *Elementary School Journal* 37: 212–214; November, 1936.

MONROE, W. S., AND SHORES, LOUIS. *Bibliography of Bibliographies.* New York: H. W. Wilson Company, 1936. 476 p.

New York, College of the City of. *Annotated Bibliography and Topical Index of Master of Science in Education Theses.* New York: College of the City of New York, 1934. 17 p. MS.

Northwestern University. *Summaries of Ph.D. Dissertations Submitted to the Graduate School of Northwestern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy, June–August, 1934.* Vol. 2. Evanston, Illinois: Northwestern University, 1934. 296 p.

————. *A List of Doctoral Dissertations Submitted at Northwestern University, 1896–1934.* Evanston, Illinois: Northwestern University. 1935. 27 p.

————. *Summaries of Doctoral Dissertations Submitted to the Graduate School of Northwestern University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy, June–August, 1935.* Vol. 3. Evanston, Illinois: 1935. 302 p.

Ohio State University. *Abstracts of Theses Presented by Candidates for the Master's Degree at the June Convocation, 1933.* Abstract No. 12. (The Graduate School.) Columbus, Ohio: Ohio State University Press, 1934. 289 p.

————. *Abstracts of Dissertations Presented by Candidates for the Degree of Doctor of Philosophy, Summer Quarter, 1933.* Abstract No. 13. (The Graduate School.) Columbus, Ohio: Ohio State University Press, 1934. 293 p.

————. *Abstracts of Theses Presented by Candidates for the Master's Degree, Summer Quarter, 1933.* Abstract No. 13. (The Graduate School.) Columbus, Ohio: Ohio State University Press, 1934. 313 p.

————. *Abstracts of Dissertations Presented by Candidates for the Degree of Doctor of Philosophy, Autumn Quarter, Winter Quarter, 1933–1934.* Abstracts of Doctors' Dissertations No. 14. Columbus, Ohio: Ohio State University, 1935. 233 p.

————. *Abstracts of Dissertations Presented by Candidates for the Degree of Doctor of Philosophy, Spring Quarter, 1934.* Abstracts of Doctors' Dissertations, No. 15. Columbus, Ohio: Ohio State University, 1935. 281 p.

————. *Abstracts of Dissertations Presented by Candidates for the Degree of Doctor of Philosophy, Summer Quarter, 1934.* Abstracts of Doctors' Dissertations, No. 16. Columbus, Ohio: Ohio State University, 1935. 289 p.

————. *Abstracts of Dissertations Presented by Candidates for the Degree of Doctor of Philosophy, Autumn Quarter, Winter Quarter, 1934–1935.* Abstracts of Doctors' Dissertations, No. 17. Columbus, Ohio: 1935. 322 p.

PALFREY, THOMAS R., AND COLEMAN, HENRY A. E. *Guide to Bibliographies of Theses in the United States and Canada.* Chicago: American Library Association, 1936. 48 p.

Pennsylvania State College. *Publications and Research for the Fiscal Year Ended June 30, 1934.* Pennsylvania State College Bulletin, Vol. 29, No. 10. State College: Pennsylvania State College, 1935. 45 p.

PETERS, CHARLES C. *Abstracts of Studies in Education at the Pennsylvania State College, Part 5 (1935).* Penn State Studies in Education, No. 12. State College: Pennsylvania State College, 1935. 55 p.

PETERS, CHARLES C., AND HARTMAN, GEORGE W. A. *Abstracts of Studies in Education at Pennsylvania State College, Part 4.* Penn State Studies in Education, No. 9. State College: Pennsylvania State College, 1934. 79 p. MS.

PIEPER, CHARLES J. "Research Studies Relating to the Teaching of Science." *Science Education* 18: 112–116; April, 1934.

Pittsburgh, University of. *Abstracts of Theses, Researches in Progress, and Bibliography of Publications,* Vol. 10, 1934. University of Pittsburgh Bulletin, Vol. 31, No. 1. (The Graduate School.) Pittsburgh, Pennsylvania: University of Pittsburgh, 1934. 676 p.

————. *Abstracts of Theses, Researches in Progress, and Bibliography of Publications,* Vol. 11, 1935. University of Pittsburgh Bulletin, Vol. 32, No. 1. Pittsburgh: University of Pittsburgh, 1935. 425 p.

Stanford University. *Abstracts of Dissertations for the Degrees of Doctor of Philosophy and Doctor of Education.* Stanford University Bulletin, Fifth Series, No. 178. Stanford: Stanford University, 1934. 192 p.

————. *Abstracts of Dissertations for the Degrees of Doctor of Philosophy and Doctor of Education, with the Titles of Theses Accepted for the Degrees of Master of Laws, Engineer, Master of Education, and Master of Arts, 1934–1935.* Stanford University Bulletin, Vol. 10. Sixth Series, No. 18. Stanford: Stanford University, 1935. 213 p.

Teachers College, Columbia University. *Annotated Bibliography of Research Studies, June, 1931, to February, 1934.* New York: Institute of School Experimentation, Teachers College, Columbia University, 1934. 15 p.

————. "Library Materials for the Study and Teaching of Science." *Library Consultant,* No. 9, April, 1936. New York: Office of the

Library, Teachers College, Columbia University, 1936.

Temple University. *Studies in Education and Psychology* (abstracts). Temple University Bulletin, Vol. 1. Philadelphia: Teachers College, Temple University, 1934. 64 p.

TOUTON, FRANK C. (Chairman). "Theses Written in California University in Candidacy for Graduate Degrees during the Academic Year 1933–1934." *California Journal of Secondary Education* 10: 58–67; October, 1934.

United States Department of Interior, Office of Education. *Bibliography of Research Studies in Education, 1932–1933.* Bulletin, 1934, No. 7. Washington, D. C.: Government Printing Office, 1934. 349 p.

————. *Bibliography of Research Studies, 1933–1934.* Bulletin, 1935, No. 5. Washington, D. C.: Government Printing Office, 1935. 328 p.

————. *Bibliography of Research Studies in Education, 1934–1935.* Bulletin, 1936, No. 5. Washington, D. C.: Government Printing Office, 1936. 287 p.

————. *Summaries of Studies in Agricultural Education.* Vocational Education Bulletin, No. 180. Agricultural Series, No. 18. Washington: Government Printing Office, 1935. 196 p.

Virginia, University of. *Publications and Research.* Vol. 2, No. 4. University of Virginia Record. Extension series, Vol. 19, No. 6. Charlottesville: University of Virginia, 1935. p. 325–478.

Wichita, Municipal University of. *Dissertations Accepted for Higher Degrees in the Graduate School.* Wichita, Kansas: Municipal University of Wichita, 1935. 11 p.

B. REFERENCES CONTAINING SUGGESTIONS FOR PROBLEMS AND CRITIQUES OF STUDIES

CALDWELL, O. W. "Research and Elementary Science Teaching." *Science Education* 18: 65–68; April, 1934.

————. "A Summary of Investigations Regarding Superstitions and Other Unfounded Beliefs." *Science Education* 20: 1–6; February, 1936.

CURTIS, FRANCIS D. "Curriculum Investigation at the Elementary and Secondary School Levels." *Review of Educational Research* 4: 165–168; April, 1934. (See also "Bibliography," p. 228–229.)

GOOD, C. V., AND OTHERS. "A Symposium on Participation of the Field Worker in Educational Research." *Journal of Educational Research* 29: 81–153; October, 1935.

HURD, A. W. "Experimental Efforts to Improve the Teaching of Physics." *Science Education* 18: 18–22; February, 1934.

KNOX, W. W. "The Demonstration Method of Teaching Chemistry." *Journal of Chemical Education* 13: 166–171; April, 1936.

POWERS, SAMUEL RALPH. "Science." *Review of Educational Research* 4: 473–478; December, 1934. (See also "Bibliography," p. 530–531.)

————. "Science." *Review of Educational Research* 5: 70–74; February, 1935. (See also "Bibliography," p. 114–115.)

PRALL, CHARLES E. "Application of Research Results." *Journal of Higher Education* 6: 425–434; November, 1935.

ROBERTSON, M. L. "A Review and Evaluation of the Curricular Studies Pertaining to Elementary Science." *Science Education* 18: 86–93; April, 1934.

C. GENERAL REFERENCES ON EDUCATIONAL RESEARCH

ALEXANDER, O. *How to Locate Educational Information and Data.* New York: Bureau of Publications, Teachers College, Columbia University, 1935. 272 p.

BOYD, T. A. *Research: The Pathfinder of Science and Industry.* New York: D. Appleton-Century Company, 1935. 319 p.

CAMPBELL, W. G. *A Form Book for Thesis Writing.* Los Angeles, California: University of Southern California Press, 1936. 145 p.

COLE, ARTHUR H., AND BIGELOW, KARL W. *A Manual of Thesis Writing.* New York: John Wiley and Sons, Inc., 1935. 51 p.

GOOD, C. V., BARR, A. S., SCATES, DOUGLAS E. *The Methodology of Educational Research.* New York: D. Appleton-Century Company, 1936. 882 p.

MCSWAIN, E. T., AND ALEXANDER, CARTER. "Guide to the Literature on Elementary Education." *Elementary School Journal* 35: 747–759; June, 1935.

SEYFRIED, J. E. *Principles and Mechanics of Research.* Albuquerque, New Mexico: University of New Mexico, 1935. 240 p.

D. INVESTIGATIONS

1. *History of Science Teaching*

MCHENRY, M. J. "Freshman Chemistry in America in 1850." *School Science and Mathematics* 34: 11–20; January, 1934.

MERWIN, BRUCE W. "Development of the Curriculum in College Chemistry." (In Kansas.) *Journal of Chemical Education* 12: 541–543; November, 1935.

2. *Present and Past Status of General Aspects of Conditions in the Teaching of Science*

BOONE, E. S., AND JAMESON, A. P. "The Training of Science Teachers Serving in California High Schools." *California Quarterly of Secondary Education* 9: 350–359; June, 1934.

CLEMENT, J. A., AND CLEVENGER, A. W. "A Critical Study of Curriculum Offerings." *North Central Association Quarterly* 10: 207–218; October, 1935.

COOKE, DENNIS H. "Subject Combinations in Departmentalized High Schools." *Elementary School Journal* 34: 526–532; March, 1934.

DOUGLASS, HARL R., AND STROWD, RAYMOND B. "The Education and Teaching Load of Science Teachers in Minnesota High Schools." *Educational Administration and Supervision* 22: 419–426; September, 1936.

DUNBAR, RALPH E., AND MANON, ALICE. "Subjects Taught by High School Chemistry Teachers of South Dakota." *Journal of Chemical Education* 11: 528–529; September, 1934.

Educational News and Editorial Comment. "Trends in the Offerings in the High Schools of Nebraska." *The School Review* 44: 413–414; June, 1936.

HAND, HAROLD C., AND CURLEY, VERNA A. "Class Size in American Secondary Schools." *California Journal of Secondary Education* 10: 175–177; February, 1935.

HOLTZ, H. G. "Five Year Trends in the Development of North Central Association High Schools, 1930–1935." *North Central Association Quarterly* 10: 412–421; April, 1936.

HULL, J. D., JR. "Factors Determining the per Pupil Cost of Instruction in High Schools." *The School Review* 42: 40–53; January, 1934.

NOLL, VICTOR H. "The Extent of Chemical Education." *Journal of Chemical Education* 12: 475–481; October, 1935.

OSBORN, H. D. "Biology Enrollment and Curriculum Placement in California Secondary Schools." *Science Education* 20: 214–216; December, 1936.

POWERS, H. W. "The Offering in Trade, Vocational and Technical Schools." *The School Review* 43: 337–349; May, 1935.

RICKSECKER, C. W. "High School Subject Cost in Ohio." *University of Pittsburgh Bulletin*, Vol. 31, No. 1, 1934.

SAUPE, E. M., AND DOUGLASS, H. R. "The Professional Load of Teachers in the Secondary Schools of Iowa." *The School Review* 43: 428–433; June, 1935.

SHEA, J. F. "The Status of Science in Colleges and Universities." *School Science and Mathematics* 36: 647–650; June, 1936.

United States Department of Interior, Office of Education. *Statistical Summary of Education, 1933–1934.* Bulletin, 1935, No. 2, Chapter I of the Biennial Survey. Washington, D. C.: Government Printing Office, 1937. 14 p.

———. *Statistics of State School Systems, 1933–1934.* Bulletin, 1935, No. 2. Chapter II of the Biennial Survey. Washington, D. C.: Government Printing Office, 1936. 111 p.

———. *Statistics of Private Elementary and Secondary Schools, 1932–1933.* Bulletin, 1935, No. 2. Chapter VI of the Biennial Survey. Washington, D. C.: Government Printing Office, 1936.

———. *Junior Colleges.*. Bulletin, 1936, No. 3. Washington, D. C.: Government Printing Office, 1936. 86 p.

———. *Elementary School Graduating Examinations.* Bulletin, 1935, No. 16. Washington, D. C.: Government Printing Office, 1936. 64 p.

WHITTON, EMMA. "Science in South Carolina Schools." *Journal of Chemical Education.* 11: 578–579; October, 1934.

WINOKUR, MORRIS. "A Survey of Generalized Science Courses in Institutions of Higher Education." *Science Education* 20: 132–140; October, 1936.

ZIELBAUER, EDWARD V. "The Status of Geology in Junior Colleges." *School and Society* 43: 407–408; March 21, 1936.

3. *Sequence and Articulation of Courses in Science*

CUNNINGHAM, B. "A Study of the Effect of a Course in High School Biology on Performance in College Biology." *School Science and Mathematics* 34: 578–588; June, 1934.

DAVIS, JAMES P. "The Science Curriculum of the Junior College." *Junior College Journal* 5: 299–303; March, 1935.

DAY, JESSE E. "University Recognition of Proficiency in High School Chemistry." *Journal of Chemical Education* 12: 166–168; April, 1935.

GILLILAND, A. R. "The Measurable Effects of Zoology on Psychology Grades." *Journal of Educational Psychology* 26: 384–387; May, 1935.

HILL, LYLE O. "Results of a Short First Year College Course for Students Who Have Had High School Chemistry." *Journal of Chemical Education* 12: 323–324; July, 1935.

HUMPHREYS, J. ANTHONY. "General Education and Specialization." *Journal of Higher Education* 7: 296–303; June, 1936.

JONES, EDWARD S. (Editor), MILLS, HENRY C., WAGNER, MAZIE EARLE, ECKERT, RUTH E. *Studies in Articulation of High School and College.* University of Buffalo, Studies, Vol. 9. Series 1. Buffalo: University of Buffalo, 1934. 319 p.

ROGERS, HERBERT W. "Science in Secondary School and College." *School and Society* 40: 334–336; September 8, 1934.

WAKEHAM, G. "High-School Subjects and General College Chemistry." *School and Society* 41: 739–740; June 1, 1935.

4. *General Objectives of the Teaching of Science*

BENNETT, WILMA. *Occupations and Vocational Guidance.* New York: The H. W. Wilson Co., 1936. 123 p.

BOWMAN, R. E. (Chairman). "Report of the Committee on Chemical Education of the Non-Collegiate Type. Objective No. 2, Part I. *Journal of Chemical Education* 11: 54–56; January, 1934.

LICHTENSTEIN, ARTHUR. *Can Attitudes Be Taught?* Johns Hopkins University, Studies in Education, No. 21. Baltimore, Md.: Johns Hopkins Press, 1934. 89 p.

ROBERTSON, J. L. "The Selection of Science Principles Suitable as Goals of Instruction in

the Elementary School." *Science Education* 19: 1–9; February, 1935.

SMITH, OTTO M. "Accepted Objectives in the Teaching of General College Chemistry." *Journal of Chemical Education* 12: 180–183; April, 1935.

SYMONDS, P. M. "Life Problems and Interests of Adolescents." *The School Review* 44: 506–518; September, 1936.

5. *Selection and Organization of the Content of Courses in Science*

a. *General Studies*

BELL, VIOLA M. *Chemistry Used in Foods and Nutrition Courses.* Ohio State University, Bureau of Educational Research. Monograph No. 2. Columbus, Ohio: Ohio State University, 1936.

LANKFORD, JR., F. G. "Current Trends in the Development of Units in Mathematics and Science." *University of Virginia Record,* Extension Series, Vol. 19, No. 3. Secondary Education in Virginia, No. 20. Charlottesville, Va.: University of Virginia, 1934. p. 26–40.

MAXWELL, P. A. "A List of Objectives for Cultural Natural Science in the Junior High School." *School Science and Mathematics* 34: 875–880; November, 1934.

MCCALMONT, J. K. "The Instructional Background of General Science Pupils in a City Community." *The School Review* 44: 291–297; April, 1936.

MERIAM, JUNIUS L. "A Critical Survey of 1000 Activities." *Journal of Experimental Education* 2: 327–332; June, 1934.

OSBORNE, R. W. "A Modified Program in Science in Experimental College Entrance Units." *North Central Association Quarterly* 10: 359–364; January, 1936.

PRUITT, CLARENCE M. *An Analysis, Evaluation and Synthesis of Subject Matter Concepts and Generalizations in Chemistry.* New York: the Author, 525 West 120th St., 1935. 176 p.

SEASHORE, R. H. "Qualitative Aspects in the Improvement of Science Teaching." *University of Oregon Bulletin,* Part II, March, 1935. p. 130–184.

SCHULTZ, JOHN P., AND HARAP, HENRY. "A Functional Course in Chemistry." *Journal of Experimental Education* 2: 333–338; June, 1934.

SWARTZ, D. J. "The Solution of a Specific Problem in Revising a Course of Study in Geography. *Journal of Educational Research* 29: 292–297; December, 1935.

WRAY, R. P. "Organization of Secondary School Chemistry According to Utilitarian Principles." *Science Education* 19: 141–149; December, 1935.

b. *Analyses of Textbooks and Courses of Study*

AGNESE, SISTER M. "Biographical Content of High School Chemistry Textbooks." *School Science and Mathematics* 36: 595–603; June, 1936.

BELL, VIOLA M., AND BURRELL, R. C. "A Revised Chemistry Curriculum for a School of Home Economics." *Educational Research Bulletin* (Ohio State) 16: 195–201; October, 1936.

BRAY, W. J. "The Selection of High School Science Textbooks." *Science Education* 18: 147–151; October, 1934.

DUNBAR, RALPH E., AND BETTS, HELEN JO. "The Problem Content of Twelve High School Chemistry Textbooks." *Journal of Chemical Education* 12: 187–189; April, 1935.

FRANK, J. O., AND LUNSTED, LESTER. "Historical Materials in High School Chemistry Texts." *Journal of Chemical Education* 12: 367–369; August, 1935.

HARAP, HENRY. "A Survey of Courses of Study Published in the Last Two Years." *Journal of Educational Research* 28: 641–656; May, 1935.

———. "Survey of Twenty-Eight Courses in Consumption." *The School Review* 43: 497–507; September, 1935.

KOOS, LEONARD V. "Consumer Education in the Secondary School." *The School Review* 42: 737–750; December, 1934.

WEBB, N. E., AND VINAL, W. G. "Subject Matter Topics in Biology Courses of Study." *School Science and Mathematics* 34: 829–841; November, 1934.

c. *Analyses of the Consensus of Teachers*

BURGESS, A. E. "The Curriculum School as a Method of Building a Course of Study in Elementary Science." *Science Education* 18: 216–221; December, 1934.

HURD, A. W. "How Shall Science Instruction Be Organized?" *Science Education* 18: 106–112; April, 1934.

d. *Analyses of Science in Magazines, Newspapers and Reference Books*

e. *Analyses of Children's Interests and Activities*

BALL, H. R. V. "Children's Interests and Experience in Relation to Science." *School Science Review* (London) 17: 321–330, 565–574; March, June, 1936.

BOYNTON, PAUL L. "The Wishes of Elementary School Children." *Peabody Journal of Education* 13: 165–174; January, 1936.

FITZPATRICK, F. L. "Pupil Testimony Concerning Their Science Interests." *Teachers College Record* 38: 381–388; February, 1937.

LEINING, EDNA B. *Millions of Years in a Winter.* Lincoln School Curriculum Studies. New York: Lincoln School, 1935. 197 p.

MCCALMONT, JOHN K. "The Instructional Background of General Science Pupils in a City Community." *The School Review* 44: 291–297; April, 1936.

PUNKS, HAROLD H. "Leisure Time Attitudes and Activities of High School Students." *School and Society* 43: 884–886; June 27, 1936.

SYMONDS, PERCIVAL M. "Sex Differences in the Life Problems and Interests of Adolescents." *School and Society* 43: 751–752; May 30, 1936.

———. "Life Problems and Interests of Adolescents." *The School Review* 44: 506–518; September, 1936.

———. "Comparison of the Problems and Interests of Young Adolescents Living in City and Country." *The Journal of Educational Sociology* 10: 231–236; December, 1936.

f. *Analyses of Adult Interests and Activities*

DUNBAR, R. E., AND TUSSING, L. "Questionnaire Study of Student Expectancy from a Course in General Chemistry." *Science Education* 20: 75–77; April, 1936.

PIPER, R. F. "Freshmen Preferences: Studies in College Orientation." *School and Society* 41: 374–376; March 16, 1935.

WALTERS, SISTER ANNETTE, AND EURICH, A. C. "A Quantitative Study of the Major Interests of College Students." *Journal of Educational Psychology* 27: 561–571; November, 1936.

g. *Analyses of Examinations*

HENDRICKS, B. C., AND SMITH, O. M. "Measurable Objectives for General College Chemistry." *School Science and Mathematics* 36: 747–751; October, 1936.

NEWLAND, T. ERNEST, AND MOORE, ROBERT S. "An Analysis of the New York State Regents Examinations in Chemistry from 1927 to 1934." *Journal of Experimental Education* 4: 359–363; June, 1936.

h. *Studies of Superstitions and Mistaken Ideas*

CALDWELL, OTIS W., AND LUNDEEN, GERHARD E. "Further Study of Unfounded Beliefs among Junior High School Pupils." *Teachers College Record* 36: 35–52; October, 1934.

DUDYCHA, GEORGE J. "The Beliefs of College Students Concerning Evolution." *The Journal of Applied Psychology* 18: 85–96; February, 1934.

JERSILD, ARTHUR T., AND HOLMES, FRANCES B. "Some Factors in the Development of Children's Fears." *Journal of Experimental Education* 4: 133–141; December, 1935.

———. *Children's Fears.* Child Development Monograph No. 20. New York: Bureau of Publications, Teachers College, Columbia University, 1935. 358 p.

MALLER, J. B., AND LUNDEEN, G. L. "Superstition and Emotional Maladjustment." *Journal of Educational Research* 27: 592–617; April, 1934.

i. *Studies of Vocabularies*

MCMURRY, ROBERT N. "Science versus Superstition in China." *School and Society* 41: 427–431, March 30, 1935.

j. *Studies of Mathematics in Science*

6. *Prognosis and Diagnosis of Abilities in Science*

DAVIS, IRA C. "The Measurement of Scientific Attitudes." *Science Education* 19: 117–122; October, 1935.

HENDRICKS, B. CLIFFORD. "Testing for a Mastery of the Principles of Chemistry." *Science Education* 18: 212–215; December, 1934.

LONG, C. H. "Sectioning a General Physics Lecture Course in Order to Adapt Instruction to Ability." *School Science and Mathematics* 36: 510–514; May, 1936.

MORTON, R. L., AND MILLER, L. H. "A Comparative Study of the Scholarship Records of Students Who Major in Mathematics." *School Science and Mathematics* 36: 965–967; December, 1936.

REITZ, W. "Forecasting Marks of New Plan Students at the University of Chicago." *The School Review* 43: 34–48; January, 1935.

REUSSER, W. C., BRINEGAR, V., AND FRANK, G. "Predicting Success in First Year College Chemistry." *School and Society* 40: 197–200; August 11, 1934.

SEGAL, DAVID. "Differential Prediction of Scholastic Success." *School and Society* 40: 91–96; January 20, 1934.

———. *Prediction of Success in College.* United States Office of Education Bulletin No. 15. Washington, D. C.: Government Printing Office, 1934. 98 p.

SEGAL, D., AND BRINTLE, S. L. "The Relation of Occupational Interest Scores as Measured by the Strong Interest Blank to Achievement Test Results and College Marks in Certain College Subject Groups." *Journal of Educational Research* 27: 442–445; February, 1934.

SMITH, CHARLES G. "Mental Ability and Achievement in Physics." *California Journal of Secondary Education* 11: 110–112; February, 1936.

WAGNER, MAZIE E., AND STRABEL, EUNICE. "Predicting Success in College Physical Sciences." *Science Education* 19: 4–9; February, 1935.

WRIGHTSTONE, J. WAYNE. "Correlation of Natural Science Beliefs and Attitudes with Social and Intellectual Factors." *Science Education* 18: 10–12; February, 1934.

7. *Psychology of Learning in Science*

BEDELL, R. C. "The Relationship between the Ability to Recall and the Ability to Infer in Specific Learning Situations." *Science Education* 18: 158–162; October, 1934.

———. *The Relationship between the Ability to Recall and the Ability to Infer in Specific Learning Situations.* Bulletin of the Northeast Missouri State Teachers College, No. 9, Vol. 34. Kirksville, Missouri: Northeast Missouri State Teachers College, 1934.

BROWN, F. E., AND COONS, R. R. "Treatment of Students Earning Low Grades." *Journal of Chemical Education* 11: 579–581; October, 1934.

CAMPSEN, H. M., JR., AND KRONICK, J. E. "The Relation of Failure in Chemistry to Reading." *High Points* 16: 12–16; December, 1934.

CROXTON, W. C. "Pupils' Ability to Generalize." *School Science and Mathematics* 36: 627–634; June, 1936.

FRANZEN, CARL G. F. "An Experiment in the Content of High School Biology." Twenty-first Conference on Educational Measurements. *Bulletin of the School of Education* (Indiana University) 11: 45–51.

HARRISON, M. LUCILLE. "The Nature and Development of Concepts of Time among Young Children." *Elementary School Journal* 34: 507–514; March, 1934.

HAUPT, G. W. "An Experimental Application of a Philosophy of Science Teaching in an Elementary School." *Science Education* 18: 234–238; December, 1934.

———. "Grade Placement in Elementary School Science." *School Science and Mathematics* 35: 858–864; November, 1935.

———. *An Experimental Application of the Philosophy of Science Teaching in an Elementary School.* Contributions to Education No. 633. New York: Bureau of Publications, Teachers College, Columbia University, 1935. 109 p.

HULL, CLARK L. "The Mechanism of the Assembly of Behavior Segments in Novel Combinations Suitable for Problem Solution." *The Psychological Review* 42: 219–245; May, 1935.

HURD, A. W. "Sex Differences in Achievement in Physical Science." *Journal of Educational Psychology* 25: 70; January, 1934.

———. "What Factors Make for Good or Poor Achievement in Science?" *Science Education* 20: 4–7; February, 1936.

PRESTON, CARLETON E. "A Rough Test of Science Reading Skills." *The High School Journal* 18: 285–288; December, 1935.

TYLER, RALPH W. "Some Findings from Studies in the Field of College Biology." *Science Education* 3: 133–142; October, 1934.

WILLIAMS, DONALD C. "Scientific Method and the Existence of Consciousness." *The Psychological Review* 41: 461–479; September, 1934.

WRIGHTSTONE, J. WAYNE. "Correlations among Tests on High School Subjects." *The School Review* 43: 198–201; March, 1935.

8. *Methods of Teaching Science*

a. *General Studies*

BRYAN, ARTHUR H. "Student Choice of Methods of Instruction in Biology." *The Educational Screen* 15: 243–244; October, 1936.

CLEMENSON, JESSIE W. "Vitalizing High School Science Through the Learning Process." *Science Education* 19: 49–56; April, 1935.

DUEL, H. W. "The Effect of a Shortened Class Period upon Achievement in High School Physics." *Science Education* 20: 157–159; October, 1936.

EWAN, S. N., JR. *The Relation of Class Size and Selected Teaching Methods to Pupil Achievement.* Philadelphia, Pa.: University of Pennsylvania, 1934. 109 p.

FOX, T. D. "The Discovery of Better Teaching Techniques for General Science." *Science Education* 19: 9–12; February, 1935.

HURD, A. W. "Experimental Efforts to Improve the Teaching of Physics." *Science Education* 18: 18–22; February, 1934.

LINGREN, V. C. "The Relative Instructional Values of Four Methods of Correcting Objective Tests in High School Chemistry." *Science Education* 19: 123–128; October, 1935.

MULROY, ESTHER FARROW. "Marks Made Following a Program of Remedial Instruction." *The School Review* 44: 753–758; December, 1936.

SIMMONS, MAITLAND P. "Changing Conceptions of Teaching Helps in General Science Textbooks." *Science Education* 20: 211–214; December, 1936.

WRIGHTSTONE, J. WAYNE. *Appraisal of Newer Practices in Selected Public Schools.* New York: Bureau of Publications, Teachers College, Columbia University, 1935. 117 p.

b. *Studies Comparing Relative Effectiveness of Various Techniques*

ALPERN, M. L. "A Comparative Study of the Effectiveness of Student Made and Prepared Drawings in College Laboratory Work in Biology." *Science Education* 20: 24–30; February, 1936.

APPLEGARTH, L. W. "Comparison of the Effectiveness of the Single Laboratory Period and the Double Laboratory Period in High School Chemistry." *School Science and Mathematics* 35: 627–633.

ATKINS, WESLEY C. *Some Probable Outcomes of Partial Self-Direction in Tenth Grade Biology.* Princeton, N. J.: Princeton University Press, 1936. 102 p.

BAILEY, R. G. "The Effect on the Achievement in Physics of Drills on the Mathematical Skills Needed in High School Physics." *School Science and Mathematics* 35: 89–91; January, 1935.

BARNARD, J. D., AND ROBERTSON, M. L. "A Comparison of the Relative Effectiveness of Two Methods of Teaching General Science." *Science Education* 20: 200–206; December, 1936.

BROWNING, C. A. "The Work Sheet for High School Physics." *Science Education* 18: 37–41; February, 1934.

DOUGLASS, HARL R., AND FIELDS, GEORGE H. "An Experimental Comparison of the Daily Assignment–Daily Recitation and a Unit Assignment in High School Chemistry." *Science Education* 20: 141–145; October, 1936.

GERBERICH, J. R., AND ROBERDS, W. M. "Individualized Instruction for Superior Students in Introductory College Physics." *Science Education* 18: 28–33; February, 1934.

HOWES, F. W. "Diagnostic Teaching of Chemistry." *School Science and Mathematics* 36: 709–713; October, 1934.

MAGRUDER, MARION V. "An Experiment in the Teaching of the Principle of Photosynthesis." *Science Education* 20: 146–150; October, 1936.

NADEN, J. L. "An Experimental Study of the Relative Values of a Direct and an Indirect Method of Teaching Study Habits in Science." *School Science and Mathematics* 35: 970–976; December, 1935.

PECK, JOHN SANFORD. *The Function of the Laboratory in Engineering Education.* New York: the Author, College of the City of New York, 1936. 96 p.

PETERSON, GEORGE W., AND DOUGLASS, HARL R. "Published Workbooks versus Pupil Made Notebooks in Ninth Grade General Science." *The School Review* 43: 608–613; October, 1935.

RICE, R. S. "Extensive Reading versus Intensive Textbook Study as a Means of Acquiring a Knowledge of Scientific Facts and Principles." *Journal of Experimental Education* 4: 376–402; June, 1936.

RILEY, C. E. "A New Trend in High School Chemistry." *School Science and Mathematics* 36: 161–173; February, 1936.

SCHELLHAMMER, F. M. "The Field Trip in Biology." *School Science and Mathematics* 35: 171–173; February, 1935.

SMITH, CHARLES G. "The Project Method in Biology." *School Science and Mathematics* 35: 83–88; January, 1935.

WRIGHTSTONE, J. W. "Experimental Practices in Biology Teaching." *School Science and Mathematics* 34: 491–497; May, 1934.

c. *Studies of Laboratory Techniques*

APPLEGARTH, L. W. "Comparison of the Effectiveness of the Single Laboratory Period and the Double Laboratory Period in High School Chemistry." *School Science and Mathematics* 35: 627–633; June, 1935.

———. "Methods of Recording Laboratory Notes in High School Chemistry." *Science Education* 19: 107–112; October, 1935.

CLEM, O. M., AND SHOUDY, H. C. "The Laboratory Technique in Secondary Science Teaching." *School Science and Mathematics* 34: 603–609; June, 1934.

LEIGHTON, R. W. *Studies of Laboratory Methods of Teaching.* University of Orgeon Bulletin, Part I, March, 1935. Eugene: University of Oregon, 1935. p. 1–129.

d. *Studies of Supplementary Techniques (Clubs, Visual Aids, Exhibits, Etc.)*

CARPENTER, HARRY A. "Teaching Science by Radio." *Junior-Senior High School Clearing House* 8: 421–427; March, 1934.

CORY, F. B. B. "High School Graduates Appraise Extra-Curriculum Activities." *The School Review* 43: 672–682; November, 1935.

HALL, W. J. "A Study of Three Methods of Teaching Science with Classroom Films." *School Science and Mathematics* 36: 968–973; December, 1936.

HINCKLEY, L. C. "An Evaluation of Motion Picture Films for Classroom Use in Biology." *Educational Screen* 15: 8–9, 20; January, 1936.

PRICE, R. H. "A Study of the Values of Field Trips." In National Education Association, Department of Elementary School Principals. *Thirteenth Yearbook.* Washington, D. C.: The Department, 1934. p. 302–306.

STODDARD, A. J. "Will Sound Pictures Tend to Increase Class Size?" *The Nation's Schools* 14: 16–19; July, 1935.

WESTFALL, LEON HARVEY. *A Study of Verbal Accompaniments to Educational Motion Pictures.* Contributions to Education, No. 617. New York: Teachers College, Columbia University, 1934. 68 p.

9. *Instructional Materials in Science*

a. *Studies of Laboratory and Classroom Equipment and Supplies*

CUNNINGHAM, H. A. "Curriculum Analysis as a Basis for Determining Science Rooms, Service, and Furnishings in Teachers' Colleges." *Science Education* 20: 151–156; October, 1936.

b. *Studies of Reading Materials*

ALYEA, H. H. "Bibliography for General Chemistry from Several Periodicals." I. Chemical and Metallurgical Engineering, Vol. 1 (1902) through 41 (1934). *Journal of Chemical Education* 13: 76–81; February, 1936.

———. "Bibliography for General Chemistry from Several Periodicals." II. Industrial and Engineering Chemistry, Vol. 1 (1909) through 26 (1934). *Journal of Chemical Education* 13: 540–544; November, 1936.

BRUCE, G. V. "Elementary School Science Reference and Instructional Materials." *Science Education* 19: 76–78, 172–177; April, December, 1935; 20: 78–82; April, 1936.

PRUITT, CLARENCE M. "Sicence Reading Materials for Pupils and Teachers." *Science Education* 20: 83–99; April, 1936.

REED, RUFUS D. (Chairman). "Report of the Committee on Chemistry Libraries." (Of the Division of Chemical Education of the American Chemical Society.) *Journal of Chemical Education* 11: 114–123; February, 1934.

SCHULTZ, M. P. "Selection of a High School Chemistry Text." *School Science and Mathematics* 35: 915–922; December, 1935.

VINAL, WILLIAM GOULD. *Nature Education—A Selected Bibliography.* Curriculum Laboratory Bulletin No. 39. Cleveland: School of Education, Western Reserve University, 1934. 82 p. MS.

WEBB, H. A. "The High School Science Library for 1933–34." *Peabody Journal of Education* 12: 57–68; September, 1934.

———. "The High School Science Library for 1934–35." *Peabody Journal Education* 13: 57–67; September, 1935.

———. "The High School Science Library for 1935–36." *Peabody Journal of Edution* 14: 57–73; September, 1936.

c. *Visual Aids*

COOK, DOROTHY E., AND RAHBEK-SMITH, EVA COTTER (Compilers). *Educational Film Catalog.* New York: The H. W. Wilson Company, 1936. 134 p. (Supplements are being issued.)

DOANE, DONALD C. "What Makes a Good Educational Film?" *The Educational Screen* 15: 271–273; November, 1936.

LUMLEY, F. H. "Suitable Radio Programs for Schools." In National Education Association, Department of Elementary School Principals. *Thirteenth Yearbook.* Washington, D. C.: The Department, 1934. p. 407–417.

MELBO, IRVING R., AND WATERMAN, IVAN R. "Pictures in Geography Textbooks." *Elementary School Journal* 36: 362–376; January, 1936.

TYLER, TRACY F. "Educational Broadcasting Resources." In National Education Association, Department of Elementary School Principals. *Thirteenth Yearbook.* Washington, D. C.: The Department, 1934. p. 403–406.

WEAVER, G. G., AND ERICSSON, E. S. *Bibliography of Technical and Industrial Motion Picture Films and Slides.* Albany: New York State, Department of Industrial Teachers.

10. *Measurement of Learning Products in Science*

BEERS, F. S. (Chairman). "Report of the Committee on Educational Testing—The 1934 College Sophomore Testing Program." *The Educational Record* 15: 507–516; October, 1934; 16: 471–481; October, 1935; 17: 606–608; October, 1936.

BUCKINGHAM, G. E., AND LEE, R. E. "A Technique for Testing Unified Concepts in Science." *Journal of Educational Research* 30: 20–27; September, 1936.

CARROLL, J. S. "An Economic Phase of Education." *Science Education* 18: 100–103; April, 1934.

CLEM, ORLIE M., AND HOVEY, CHESTER W. "Comparative High School Achievement of Pupils from Village Schools and Rural Elementary Schools." *Journal of Educational Research* 30: 285–289; December, 1936.

DAVIS, IRA C. "The Measurement of Scientific Attitudes." *Science Education* 19: 117–122; October, 1935.

DIAMOND, L. N. "The Testing Movement in High School Biology." *School Science and Mathematics* 34: 39–49; January, 1934.

DOWNING, E. R. "Some Results of a Test on Scientific Thinking." *Science Education* 20: 121–128; October, 1936.

EDWARDS, C. W. "The Effect of the Time Factor in the Administration of Tests." *School Science and Mathematics* 36: 85–91; January, 1936.

FRUTCHEY, F. P., TYLER, R. W., AND HENDRICKS, B. C. "Measuring the Ability to Interpret Experimental Data." *Journal of Chemical Education* 13: 62–64; February, 1936.

GRAY, HOWARD A. "An Approval to the Measurement of Biological Attitudes." *Journal of Educational Research* 28: 25–29; September, 1934.

HOEFER, CAROLYN, AND HARDY, MARTHA CRUMPTON. "Some Influences of a Health-Education Program during the Elementary School Years." *Elementary School Journal* 35: 368–382; January, 1935.

HOFF, A. G. "A Test for Scientific Attitude." *School Science and Mathematics* 36: 763–770; October, 1936.

HOPKINS, L. THOMAS, AND MENDENHALL, JAMES E. *Achievement at Lincoln School: A Study of Academic Tests Results in an Experimental School.* New York: Bureau of Publications, Teachers College, Columbia University, 1934. 65 p.

HORNEY, A. G. "An Objective Essay Examination in Chemistry." *School Science and Mathematics* 34: 380–387; April, 1934.

———. "Testing the Achievement of Students in Chemistry." *Journal of Chemical Education* 11: 360–366; June, 1934.

HYATT, ALTON R. "The Achievement of Secondary School Pupils on College Science Tests." *The Educational Record* 17: 135–160 (Supplement No. 10); January, 1936.

JOHNSON, P. O. "The Measurement of Outcomes of Instruction other than Information." *School Science and Mathematics* 34: 26–33; January, 1934.

———. "Concomitant Learning in Human Biology." *Science Education* 20: 11–20; February, 1936.

———. "The Differential Functions of Examinations." *Journal of Educational Research* 30: 93–103; October, 1936.

LICHTENSTEIN, ARTHUR. "The Effect of Teaching Stress Upon an Attitude." *Science Education* 19: 73–75; April, 1935.

NOLL, VICTOR H. "Measuring Scientific Thinking." *Teachers College Record* 35: 685–693; May, 1934.

PALMER, FREDERICK, JR. "The College Physics Testing Program and Its Significance for Guidance in Secondary Schools." *The Educational Record* 16: 82–96; January, 1935.

STEWART, A. W. "Measuring Ability to Apply Principles." *School Science and Mathematics* 35: 695–699; October, 1935.

TYLER, R. W. *Constructing Achievement Tests.* Columbus, Ohio: Bureau of Educational Research, Ohio State University, 1934. 110 p.

———. "Some Findings from Studies in the Field of College Biology." *Science Education* 18: 133–142; October, 1934.

WRIGHTSTONE, J. W. "Correlation of Natural Science Reliefs and Attitudes With Social and Intellectual Factors." *Science Education* 18: 10–12; February, 1934.

11. *Education, Demand and Supply of Teachers of Science*

BOONE, ELEANOR S., AND PRINGLE, JAMESON A. "The Training of Science Teachers Serving in California High Schools." *California Quarterly of Secondary Education* 9: 350–359; June, 1934.

BRECHBILL, HENRY. "The Value to Science Teachers of a Course in the Teaching of Science." *Educational Administration and Supervision* 20: 541–547; October, 1934.

———. "Status of College and University Offerings in the Teaching of Science." *Science Education* 18: 221–225; 19: 60–65; December, 1934; April, 1935.

CAMPBELL, D. S., AND OTHERS. *The Education of Secondary School Teachers.* Report of Joint Committee on Study of Curricula of the Southern Association of Colleges and Secondary Schools. Nashville, Tenn.: George Peabody College (Division of Surveys and Field Studies), 1936. 203 p.

HADSALL, L. F. "The Extension Activities of Certain Publicly Supported Institutions in Assisting Teachers in Service in Elementary Science or Nature Study." *Science Education* 20: 7–11; February, 1936.

HURD, A. W. "Some Aspects of the Education of Teachers of Science in State Teachers Colleges and Normal Schools." *Educational Administration and Supervision* 20: 35–44; January, 1934.

MALMBERG, C. F. *Teaching Positions in Illinois High Schools.* The Teachers College Quarterly, Series 33, No. 134. Normal, Illinois: Illinois State Normal University, October, 1935. 40 p.

North Central Association. "Reports Relating to the General and Specialized Subject-Matter Preparation of Secondary School Teachers." *North Central Association Quarterly* 10: 219–255; October, 1935.

POTTHOFF, EDWARD F. "Teaching Combinations: Reductio ad Absurdum." *The School Review* 43: 417–427; June, 1935.

SHARP, L. A. "A Study of High School Positions in Texas, 1931–1932." *Bulletin of North Texas State Teachers College.* Denton: Texas Teachers College Press, March, 1936. 28 p.

United States Department of Interior, Office of Education. *Bibliography on Teacher Education.* Pamphlet No. 66. Washington, D. C.: Government Printing Office, 1936.

WATKINS, R. K. "The Preparation of High School Science Teachers in Terms of the Market." *Science Education* 20: 56–60; April, 1936.

12. *Supervision and Administration of Science Instruction*

13. *The Teaching of Science in Foreign Schools*

GILLESPIE, ALEX. S. "Biology in the Education of New Germany." *The School Science Review* (London) 17: 398–410; March, 1936.

TURNER, F. W. "English School Examinations." *Science Education* 18: 23–27; February, 1934.

Classroom Notes

The Wheatstone circuit is not outmoded.—The fact that the Wheastone circuit gives such accurate results in the measurement of electrical resistance and that some industrial applications have been made of it, for instance, in the measurement of temperature and of the percentage of carbon dioxide in gases, indicate that this circuit has merit, and is not to be replaced by electron tubes which seem to be the style today.

A study of the Wheatstone circuit, in connection with simple auxiliary apparatus indicates the following uses:

(1) Measurement of electrical resistance with the use of the formula $X = Rm/n$;

(2) Measurement of electrical resistance without computations—as an ohmmeter;

(3) Multiplication and division of numbers and computation of ratios, as an electrical slide rule;

(4) Measurement—indicating and recording—and control of: (a) Percentage of carbon dioxide; (b) Temperature; (c) Pressure and vacuum; (d) Specific gravity of liquids; (e) Liquid level; (f) Fluid flow; (g) Intensity of illumination; (h) Weight.

This list doubtless does not exhaust the possible uses of the Wheatstone circuit but it does indicate that it is a circuit which is worthy of inclusion in every high-school physics course.

From the educational standpoint, neither the old type slide-wire bridge nor the postoffice bridge is satisfactory. The pupils cannot see how a single length of wire can be two resistances in the case of the former and it is difficult for them to trace the circuit of the postoffice type.

In order to overcome these difficulties, another type of Wheatstone bridge has been developed. This bridge is known as the Broome Bridge and is marketed by the Cambosco Scientific Company. The advantages of this bridge from the educational standpoint are as follows:

(a) The Wheatstone circuit is incorporated in the bridge with a binding post at each corner of the circuit. The posts are all within an area of four square inches so that no long wires are needed and errors in connections are practically impossible.

(b) The formula $X/R = m/n$ is embossed on the diagram so the pupils can readily set up the mathematical formulas or equations and see the relationship between the resistances and the numbers used.

(c) The two resistances are independently variable and any number of settings of "m" and "n" may be readily made.

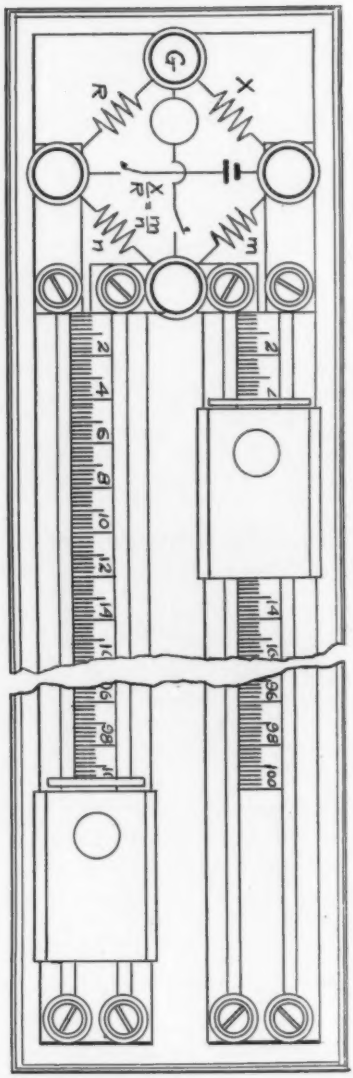


FIGURE 1.—Broome Bridge (total length 24 inches)

(d) The bridge is only two feet long so it is very convenient to use, even on small tables.

(e) Instead of one meter of resistance wire with less than one ohm resistance, there are two meters of resistance ribbon with five and one-half ohms resistance.
(f) It is low in cost.
(g) There are positive screw contacts on the ribbons.
(h) If the ribbons are accidentally damaged, they are easily replaced.

The use of the new bridge for measuring electrical resistance is much more convenient than with the other types of bridges due to the above advantages. In the use of the formula $X = Rm/n$, the value of "n" may be made some number such as 80 or 90 which makes computations simple.

By making "n" numerically equal to "R", then "X" equals "m." The bridge in this manner acts as an ohmmeter, but special resistances, such as the commercial ohmmeter requires, are not needed, since "n" is variable.

The details of the bridge are shown in figure 1 and the above operations may be readily followed by referring thereto.

The use of two of the bridges as an electric slide rule, the connections of which are shown in figure 2, is valuable not only in the teaching of physics but also mathematics. This connection gives four independently variable resistances which may be designated "m_1" and "n_1" on the upper bridge and "m_2" and "n_2" on the lower bridge. If "m_1" is set on 100, then the formula, which on any condition of balance is $n_1n_2 = m_1m_2$, becomes $n_1n_2 = 100m_2$. The reading of "m_2" with the decimal point moved two places to the right then is the product of "n_1" and "n_2." For example with "n_1" set on 80 and "n_2" set on 90, a balance will be obtained with "m_2" on 72. Moving the decimal point two places to the right gives 7200 which is, of course, the product of 80 and 90.

The rules which are used with the Mannheim slide rule for determining the position of the decimal point may be used. When the reading of "m_2" is more than 10, the same rule applies as the one used when the slider is extending from the left end of the Mannheim slide rule. When the reading of "m_2" is less than ten, the rule applying when the slider extends from the right end of the Mannheim slide rule is used.

Division, of course, will be worked in the reverse manner to multiplication. The computing of ratios requires no explanation.

While the Wheatstone circuit may be used for the measurement, recording, and controlling of temperature, pressure, liquid level, and other conditions, the Broome Bridge can, of course, only be used for measurement.

The measurement of the percentage of carbon

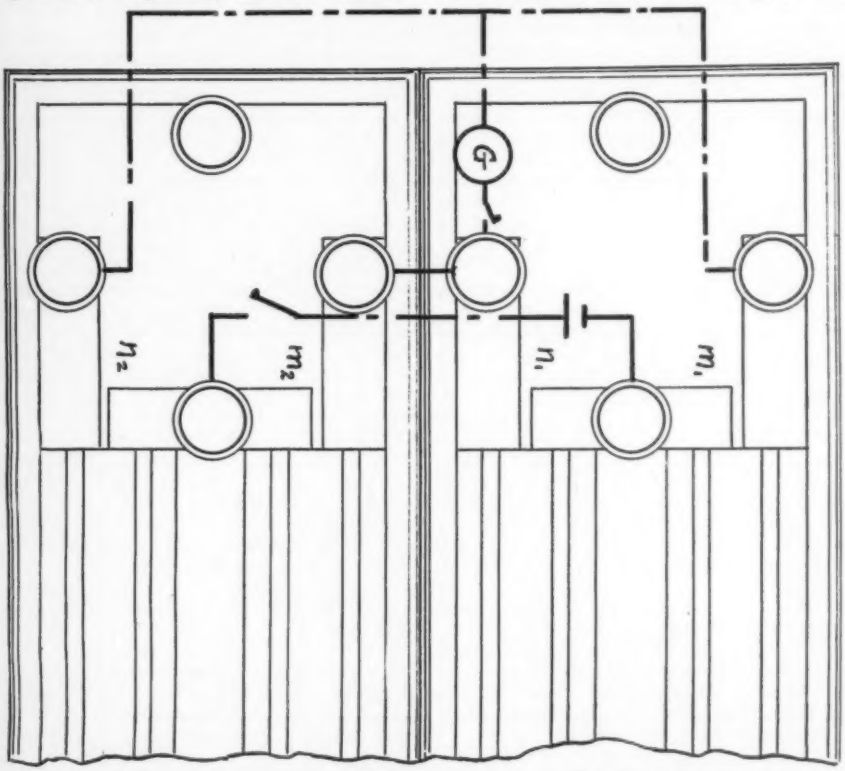


FIGURE 2.—Two Broome Bridges Connected as an Electric Slide Rule

dioxide may be accomplished with the use of two short tubes with openings at each end and lengths of #36 B. & S. platinum wire running from end to end and connected to convenient terminals. Since the electrical resistance of platinum changes in an atmosphere of carbon dioxide, the one unit will be connected to the "X" position of the bridge, and cooled gas will be passed through the tube. The other tube will be connected to the "R" position of the bridge and cooled air will be passed through it. If possible the bridge and units should be calibrated with a commercial carbon dioxide meter and a curve drawn showing the relationship between the bridge scale reading and the percentage.

In measuring temperature, two resistance units are used, preferably sealed in U-shaped glass tubing. The units should have approximately the same resistance at normal room temperature. For the "X" position unit, about one foot of #36 B. & S. platinum wire will be sealed in the glass tubing. For the "R" position unit, which may be used as a standard for the other uses to be described later, a wire with a low temperature coefficient should be used, although if it is kept at room temperature any error due to the change in its resistance will be small. The bridge and unit may be calibrated by means of placing the "X" unit and a chemical thermometer in water and cooling and heating. In place of the platinum resistance unit a unit may be made containing a solution of copper sulfate or zinc sulfate with platinum terminals sealed into the glass tubing. This will also illustrate the change of conductivity of electrolytes with temperature. A curve showing the relationship between temperature and bridge reading should of course be made.

The measurement of pressure, vacuum, specific gravity, liquid level, fluid flow, and weight make use of mercury manometers. These manometers should have about six-inch legs and in one of the legs is fastened a double length of platinum wire (#36 B. & S.) so that the lower end is secure, the two wires do not touch one another and at the upper end they are brought out to two terminals. By connecting this unit in the "X" position and the standard mentioned above in the "R" position, the mercury as it rises and falls will decrease and increase the electrical resistance of the wire due to short circuiting the two wires at different points. For high pressure, closed manometers will be used; for low pressure, open manometers; and for very small pressures, positive or negative, inclined manometers similar to boiler draft gauges. The bridge and units should be calibrated and curves should be made to show the relationships.

A venturi tube or equivalent would be used with the manometer for measuring fluid flow. A thistle tube connected to the manometer would be used for specific gravity and weight measurements. Intensity of illumination would be obtained with the use of a selenium cell and a corresponding standard resistance.

These many uses of one instrument will open the eyes of the pupils as to its real value. The instructor could demonstrate many principles with the bridge and show how the unit could be placed in an unaccessible location and the bridge in an accessible location.

On account of the two independently variable resistances. the one-half meter scales calibrated to 100, and the sliding contacts instead of plugs as on the postoffice type, the new type bridge is very convenient to use in these and other demonstrations or student experiments.

The bridge has a number of other uses which however do not involve the Wheatstone principle, such as: current flow in series and parallel circuits, potential drop along a conductor, variable rheostat, ammeter shunt, and others.

FRANK H. BROOME,
Pompton Lakes High School,
Pompton Lakes, N. J.

Riker display mounts.—Economical Riker mounts may be made by using women's hosiery boxes as frames. Cut a piece of window glass to the exact outside dimensions of the hosiery box cover. Clean the glass perfectly and set aside for later use. Place the box within the cover, inverted so that it makes a strong double-walled container. Fill the box with layers of absorbent cotton cut to fit exactly. Place the demonstration specimens on this cotton bed. If materials are very large a portion of the cotton may be removed from the lower layers directly under each specimen. Be sure that the upper cotton is smoothly and neatly arranged. Place the clean glass plate over the top as a cover, using two small pieces of tape at opposite sides of the box to hold the glass in place while you bind the edges.

A dark-colored tape, such as Dennison's binding tape, is used to fix the glass in place. Take a strip of tape slightly longer than the perimeter of the box, fold it lengthwise along the midline with the glued side inward. One-half of this tape will be glued to the glass surface, the other will be glued to the side of the box to seal the transparent cover in position. Begin attachment of the tape along a side in such a position that the final overlapping edge will occur, not at a corner, but somewhere along the side of the box. Fasten the tape until the first corner is covered. Now cut the tape to the creased midline, making the cut along the unbound edge of the glass, which is at right angles to the crease. As the remaining portion of the tape is fixed to the second side it will form a neat overlapping corner. Continue to bind all sides of the box.

LESLIE BERGEN,
University of Minnesota High School.

A chemical Christmas tree.—The author claims no particular originality for the idea presented. Chemical Christmas trees have been used previously but little if any publicity has been given to the general plan through the scientific or educational press. The following brief

description of such a novelty is offered with the hope that it may be of some service to others who may want to construct such a tree for a science club or similar party at some future date.

The "tree" is constructed essentially of articles that should be available in any college or high-school chemical laboratory. Originality and variety will add much of interest, novelty, and attractiveness to such an assemblage. A large, substantial, triangular base ring stand serves as a trunk for the "tree." A large and varied assortment of rods, rings and clamps will complete the essential construction, being fastened in place so as to resemble the largest branches of an evergreen, as far as number and positions are concerned. Flasks, retorts, and numerous other sundry pieces of glass and metallic apparatus will serve well for decorations and ornaments. The glass containers may logically be filled with colored solutions to add an effective touch. "Trees" of this type, when once construction is started, continue to grow in size and complexity without any great amount of advance planning, very much like the traditional "Topsy." A string or two of colored electric Christmas tree lights may be added as a final touch.

Such a "tree," of course, adds little if anything to an educational program, but does add a very unique touch of new interest and novelty to any Science or Chemistry Club Christmas party or program.

RALPH E. DUNBAR,
Iowa State College, Ames, Iowa.

A museum model as a construction project.—Although secondary-school pupils are surrounded by examples of physical laws, it is often difficult to arouse sufficient interest in the principles to insure an adequate grasp of their significance. Museums and expositions have demonstrated that well-planned working models in many instances furnish a most stimulating means of presenting such scientific laws. If the science instructor is mechanically inclined and is willing to put in the necessary time, it is possible, with the aid of a small group of students, to construct simplified exhibits of this type as an extra-curricular creative project. The one herein described was built to illustrate the Law of the Conservation of Energy. The work was done by a committee of six pupils from the seventh, eighth and ninth grades.

The case is constructed of plywood and measures three feet square. The background scene is painted on prest-board and stands three feet high. The "water" in the lake was made by shellacking cellophane over plywood which had previously been painted black. A sheet of cellophane "flows" over the dam while spun glass "angel's hair" represents the spray below the falls and the water flowing upon the mill wheel.

The building is made of half-inch pine and is painted white inside while the stucco outside was made by painting the structure with glue upon which sand was sprinkled. Rubberoid shingles were cut into strips and tacked to the roof.

Within the building a discarded series type electric fan motor is belted by means of an elastic band to a large pulley on the mill wheel shaft. Theoretically the mill wheel runs the "dynamo," but practically the opposite is true. In order that the speed of the wheel be not too great, a socket containing a fifty watt bulb is placed under the "lake" and connected in series with the motor. A tiny dummy switchboard is mounted on the rear wall of the room to make the power house setting complete. Knife switches were made from wire while meters are sections cut from dowel rod. Beneath the switchboard and connected thereto by means of wires is a model storage battery of the automobile type carved from a block of plaster of paris about an inch long.

Under the right-hand window, and visible in the illustration, stands a tiny electric range with two top burners and an oven below. The oven door is merely outlined on the front of the tin box which constitutes the body of the stove, but a wire handle is soldered on to make it look realistic. The top burners consist of holes cut in the top of the can, below which is a piece of ground glass painted with ivory enamel. The enamel is scratched off in a spiral so that as the light from a red bulb within the can shines, the "coils" and "porcelains" glow as if red hot.

Across the front of the case is a series of eight ground glass panels containing legends explaining each of the six energy transformations illustrated in the display, as well as one giving instructions as to how to set the mechanism in operation and another summarizing the principle set forth. Each panel is illuminated from below by a colored Christmas tree bulb, while the location of the transformation described is pointed out by a glowing jewel in the model itself. Originally a motor driven flasher switch was constructed from Erector parts and scraps of wood and metal which lighted each panel and its corresponding jewel in turn after the mechanism had been started with the push button in the left front corner of the case. During the cycle, which took about a minute, the mill wheel turned in a most natural manner. It soon became evident that the toy motor was not suited to the heavy duty type of work involved so the connections were changed to place the lights in two series strings operated directly by the button, all lights and jewels being on and the mill wheel running as long as the button was held down. At first both the Erector motor and the bulbs were operated by a twelve volt toy transformer, but this was made unnecessary by the subsequent connections.

The transformations of energy represented were:

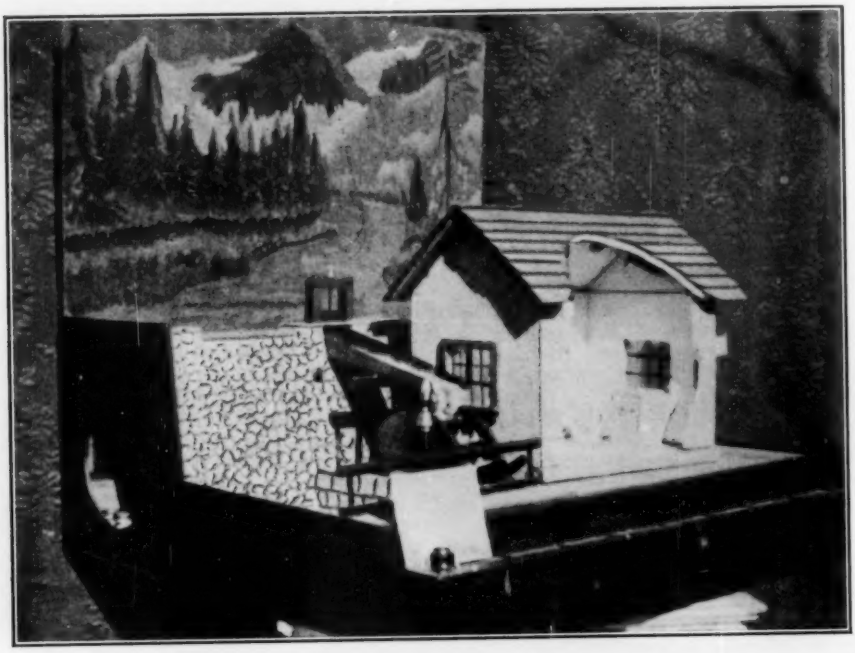
1. Potential energy of water stored behind the dam becomes kinetic energy when the gate is opened.
2. This turns the wheel thus becoming mechanical energy.

3. It is converted into electrical energy by the dynamo.
4. Electrical energy is stored in the form of chemical energy in the battery.
5. It is also converted into light by a bulb which hangs from the ceiling of the house.
6. Finally some of it is converted into heat by the range.

The law is summarized in the last panel—"Thus we see that although energy can be changed from one form to another, it can neither be created nor destroyed."

Pupils of the Denville, New Jersey, High School who cooperated in the construction of the exhibit were justly proud of their achievement, while those who saw the model operate seemed to grasp the principle of the conservation of energy to an unusual extent.

GORDON M. TAYLOR,
Vernon L. Davey Junior High School,
East Orange, N. J.



Editorials and Educational News

REPORT OF THE SIXTEENTH ANNUAL MEETING OF SCIENCE ASSOCIATION OF MIDDLE STATES

The sixteenth annual meeting of the Association was held in the Music Room of the Hotel Chalfonte, Atlantic City, November 28, 1936, with the President, Clarence E. Feick, in the chair. After some introductory remarks by the president the meeting went forward in accordance with the program, as follows:

The Philosophy Underlying a Science Program in the General Education of the Pupil. What Work is Being Carried on at the Present Time Along This Line? Anita D. Laton, University of California.

Trends of Curriculum Revision in the Aikin Experiment. A. N. Zechiel, Tower Hill School, Wilmington, Del

Discussion, led by W. R. Wright, Swarthmore College.

Some Consideration Governing the Establishment of Science Courses to Meet the Needs of General Education at the Senior High School Level. H. Emmett Brown, Lincoln School, Teachers College, Columbia University.

What Are Some of the Difficulties Confronting the Classroom Teacher in Accepting and Practicing the Aim of General Education in His Daily Work? Wilmarth I. Jacobs, Mercersburg Academy, Pa.

Discussion, led by S. R. Powers, Columbia University.

How the College Follows up the High School in the Case of Students Who Enter with Previous School Training in Science. W. B. Meldrum, Haverford College.

Report on the New Work of the College Entrance Examination Board. Robert N. Hilkert, Hill School, Pottstown, Pa.

Discussion

Business Meeting

Luncheon—Blue Room, Hotel Chalfonte, 1:00 P.M.

Reports of Committees

Discussion of policy for future progress of the Association

All of the papers brought forth considerable discussion, more indeed than the program allowed for, on questions of achievement; testing; inspired teachers; "set" problems vs. real problems; fusion courses; the "sinister" in mere facts, and other. Abstracts of the papers are appended to this report.

During the business meeting the report of the nominating committee, Robert W. McLachlan, chairman, was read as follows:

President, Merwin M. Peake, Lafayette Jr. High School, Elizabeth, N. J.

Vice-President, Robert N. Hilkert, The Hill School, Pottstown, Pa.

Secretary-Treasurer, Dena D. Ungemach, Head of Science Department, Overbrook H. S., Philadelphia.

Council, Clarence E. Feick, Head of Science Dept., South Philadelphia Boys' High School; Morris Meister, Head of Science Dept., Haaren High School, New York City; Gerald S. Craig, Teachers College, Columbia University; Q. C. Drake, Women's College, University of Delaware, Newark, Del.

As there were no other nominations from the floor, the secretary was requested to cast a ballot for the candidates named and the officers for the year 1936–37 were declared elected as given above.

The treasurer's report was read, approved and ordered spread on the minutes.

TREASURER'S REPORT FOR NOVEMBER 27, 1936

Receipts

Balance on hand in bank 11/30/35	$103.52
Cash	.75
Dues received to November 27, 1936	50.00
	154.27

Disbursements

Stationery	$ 10.25
Reprints	6.25
Postage	5.75
Clerical service	3.00
	25.25
Balance on hand November 27, 1936	129.02
	154.27

During the period of the luncheon, Mr. Rufus Reed, of Montclair, reported for the Publication Committee. The matter of publications for use of the teacher in service and of the young teacher brought up the problem of cost of professional "tools." It was recommended that both a magazine for classroom use and another for the teacher's self-improvement should be considered necessary, and that a fusion did not seem feasible. The Committee surveyed the field very thoroughly.

Mr. Meister sent a long report of what an organization like the A.S.T. could consider its concerns. The report indicates a possible program of activity for the Association in line with

its basic aim. It was accepted and will be used by the executive council and program groups.

After considerable discussion pro and con on the question of changing the dues of members to two dollars, referred to this year's meeting from last year (by Constitutional requirement) it was finally voted that the dues remain at one dollar. The meeting adjourned.

Abstracts of Papers

THE PHILOSOPHY UNDERLYING A SCIENCE PROGRAM IN THE GENERAL EDUCATION OF THE PUPIL. WHAT WORK IS BEING CARRIED ON AT THE PRESENT TIME ALONG THIS LINE?

By Anita D. Laton

Before attempting any definition of the philosophy underlying a science program in general education two preliminary statements with regard to it may well be made. First of all, it must be a philosophy held by teachers themselves, one which actually guides their work with children in the classroom rather than one which is relegated to a few unread paragraphs in a lesson plan or a course of study. Second, it is one which considers education as a whole, with science making a contribution to the whole, rather than one which concerns itself only with science.

It is comparatively simple to make a general formulation of a philosophy of education with which almost every one will agree, at least verbally. The Science Committee of the Commission of the Progressive Education Association states in one report, "The aim of general education is to promote the continuous reconstruction, improvement, and enrichment of individual and social life through the orientation of the individual in the basic relationships of living." These basic relationships they list as six. Education should orient students better in these relationships, not primarily by teaching them facts about these relationships, but by helping them to achieve certain educational values within them.

Similarly, the Bureau of Educational Research in Science bases its work on the general thesis that education should be concerned with what is significant for human living and thinking, that it should provide opportunity for students to develop ways of thinking and acting and feeling which are consistent with the sum total of human knowledge, and which will contribute to the welfare of individuals and of groups of individuals. Several research associates are now at work reviewing the literature of science to find what seems to have significance for a better understanding of ourselves, our relations to other human beings, and our relations to the rest of the animate and inanimate universe, since these are the relationships within which we must act and think and feel.

Another group is trying to discover something about learning by giving children opportunity to explore, as widely as is possible in school situations, certain great fields of human knowledge about themselves, about other people, about the universe, and the relations between them. Out of these experiences each child will build for himself certain ways of thinking, feeling, and acting. One problem then becomes to discover: how many and what new ideas they develop; whether they learn to think more critically; how their overt behavior is changed; what new interests, attitudes, and appreciations they develop; how they change their way of looking at life in general. Science makes a contribution to each of these; the educational philosophy underlying a science program in general education draws our attention to them all as we teach and as we evaluate teaching.

TRENDS OF SCIENCE REVISION IN THE SCHOOLS OF THE AIKIN EXPERIMENT

By A. N. Zechiel

The experimental work going on in the thirty schools participating in the work of the Aikin Commission shows a wide degree of variation. The science departments of the thirty schools are in general less active in experimentation than are some other departments, notably the social studies. In no one school are all the trends summarized below to be found. On the other hand, each of the trends indicated is evident in more than one school. The very word "trend" indicates a dynamic condition rather than a static one, so we find few places where teachers would be willing to say they had achieved perfection along the line they are pursuing. The following statements therefore, represent the general directions toward which the experimental work is pointing.

1. Setting up objectives of science teaching in terms of desired student behavior, so concretely stated that they can be used as criteria for the selection of content and methodology.

2. Greater emphasis upon teaching for the developments of attitudes, appreciations, and skills, and less emphasis upon content mastery.

3. Greater use of the scientific method in laboratory work. An increase in the amount of quantitative work and a decrease in descriptive and verification experiments.

4. Individualization of work and standards of achievement within a group.

5. Fusion courses, such as: (a) Physical science (fusion of physics and chemistry, in some cases also geology, physical geography, astronomy); (b) Biology and health courses; (c) Science and mathematics; (d) Science and social studies.

6. Testing for objectives rather than content testing alone.

In many schools the curriculum as such, recorded in cold print, is not startling in its newness or originality. The same materials are available and used. However, the clear definition of objectives in terms that lend themselves to some form of systematic evaluation is pro-

ducing a type of science teaching that shows evidence of an increased vitality and interest. There seems to be little doubt that for the non-college student many of the courses offered are superior to the traditional courses in physics, chemistry, and biology. Whether the college student is likewise benefited remains to be seen. The author believes that for the college student who does not intend to specialize in science in college the same conclusion will be valid. Present trends in college courses seem to be to delay specialization until the latter years of the course, which seems to indicate that specialization is decidedly out of place in high-school curricula.

SOME CONSIDERATIONS GOVERNING THE ESTABLISHMENT OF SCIENCE COURSES TO MEET THE NEEDS OF GENERAL EDUCATION AT THE SENIOR-HIGH-SCHOOL LEVEL

By H. Emmett Brown

The original statement of the aim of general education put forth by the Science Committee working under the direction of the Progressive Education Association's Commission on Secondary Curriculum was: "The aim of general education is to promote the continuous reconstruction, improvement, and enrichment of individual and social life through the orientation of the individual in the basic relationships of living." However we may attempt to state our ideal of general education (the committee is considering a new statement of this aim) the ideal is probably clearly enough held by educators to afford guidance to curriculum reform. The acceptance of this ideal and its rigorous application will result in a number of changes in senior-high-school science. These changes would probably be of four main kinds.

1. Changes in Content.—(a) Elimination of dead wood, *e.g.*, detailed work on preparation, properties and occurrence in chemistry, work on vector forces in physics, details of animals and plant structure in biology; (b) Addition of material that does contribute to orientation, *e.g.*, new material from certain other fields of science, as the geology of the region, certain aspects of astronomy and anthropology; (c) Increased social emphases, *e.g.*, the effect of the machine studied along with the machine, the bad physiological and social effects of noise in connection with the study of sound, consumer education in connection with much of the work in biology and chemistry; (d) As suggested in (b) above, certain new materials may be added. This suggests that we do not need to worry too much about subject-matter boundaries. Neither is it a virtue in itself to tear them down.

2. Changes in Organization.—(a) Organization of science instruction should not be dictated completely by the content. Instead it may be determined by the needs of the group and its individuals and certain considerations growing out of the school program of experimentation; (b) Organization shall be such as to help to secure integration, *e.g.*, a unit in light which is introduced through work on color and vision, related to biology in its study of the structure of the eye, related to social material on eye strain, related to the flow of energy from the sun, related to art in its interpretation of color, and tied in with the whole theme of the flow of energy over the earth's surface and throughout the universe.

3. Changes in Types of Activities.—In place of the usual practice of selecting activities solely (in spite of violent assertion to the contrary) for their function in helping to develop understandings, activities would be chosen for three purposes: (a) to develop understandings (as before); (b) to develop educational values; (c) to allow for individual interests and to meet individual needs. It is apparent that the same activity may develop more than one of the above. Others would have quite distinct functions. Implicit in the three points of view seem to be: (a) activities are not chosen to produce laboratory technicians or for other highly specialized purposes, except for the occasional person, (b) work rather widely separated from that of the main group may go on with certain individuals, (c) all activities are not determined in advance. Students have a share in planning and determining the length and kind of teaching unit.

4. Changes in Method.—Much of what has been said before has a direct bearing on method. In addition it may be said: (a) The approach should be through the student, *e.g.*, work in light, through vision; in sound, with hearing and the human voice; in machines with the idea of the human body as a machine, or how machines aid us in our daily work; in chemical changes with the chemistry of the life processes, and (b) If activities are selected to produce other than subject-matter understandings, then, and in any case, a more careful and expanded program of evaluation must go on.

WHAT ARE SOME OF THE DIFFICULTIES CONFRONTING THE CLASSROOM TEACHER IN ACCEPTING AND PRACTICING THE AIM OF GENERAL EDUCATION IN HIS DAILY WORK?

By Wilmarth I. Jacobs

One basic difficulty facing the classroom teacher arises from a narrow, utilitarian conception of subject-matter in terms of financial returns. The student must be educated to the point of realization that he must include in his background much that is contributory, indirectly rather than directly, to his success.

Every classroom teacher faces a difficulty which arises from faulty preparation on the part of his students. We often recognize unpreparedness in fundamental subject-matter but fail to recognize the vital necessity for preparation in character, in reasoning ability and in social attitudes for the increasing demands which education at higher levels will make on the individual.

Every teacher faces a difficulty inherent within himself because of a tendency to become less elastic and adaptable with advancing years. By conscious effort he may keep his point of view and philosophy of life within the comprehension of growing boys and girls. By this means he may derive the advantages, without the disadvantages, of years of experience.

INFLUENCES AFFECTING HUMAN ACTIVITIES

By S. R. Powers

Our society is one of individuals whose activities are continually reconstructing it. Thus it is important in educational planning to recognize these influences under (I) the natural environment, (II) the self, and (III) society.

I. The influences of the natural environment are seen from consideration of (A) man's knowledge of the world and of its changes through time, and (B) his control and use of the natural environment.

A. Man's knowledge of the world and of its changes through time includes the scientific aspects of man's world model: his concepts of history, nature, and structure of the physical universe; his realization of the interrelations of living things and of their dependence upon conditions of the physical environment; his theory of the evolution of life and of society; his understanding of the processes of nature as they relate to and condition thinking and acting, and of the nature and limitations of the scientific descriptions of the world.

B. Controls with their implications for social living include (1) controls that are useful for maintenance of personal and public health, particularly controls of bacterial disease, of conditions necessary for production of foods, and of conditions permitting a reasonable degree of physical activity; (2) controls that are useful (a) in the cultivation of plants and the rearing of animals for food, clothing and shelter; (b) in the use of plants for decorative effects and in prevention of soil erosion; (c) in the rearing and care of animals for pets, for beasts of burden, and for such recreational activities as riding, hunting, and fishing; and (d) for protection of plants and animals from parasitic pests; (3) control of energy and of its technologic utilization, and (4) controls for technologic utilization of material resources.

II. The influences of the self are seen from consideration of (A) the objective self and (B) the subjective self.

A. The self, viewed objectively, is essentially the physiological self, knowledge of which deals with (a) the exchange of matter and energy between the body and the external environment; (b) growth and development; (c) characteristics of physical vigor and how to maintain it; (d) behavior in response to environmental factors and as affected by physiological conditions; (e) sex and reproduction, and (f) the relations between parents and offspring. Out of these influences there arise the individual's persistent questions concerning his own normality.

B. The subjective self suggests psychological and anthropological knowledge of the growth and development of the mental and emotional life. This includes ideals and attitudes, the creative and reflective personal life, and qualities of personality and personality differences. From these also there come the persistent questions of normality.

III. The influences of society are seen from consideration of (A) the family and (B) the Great Community.

A. Family relationships suggest knowledge of (a) group psychology; (b) scientific needs of the home; (c) adjustments in matters of sex including birth control; (d) care and feeding of children, and (e) adjustments between parents and children.

B. The Great Community suggests (a) racial differences; (b) social and political institutions—the school, the church, and the club, and local, national, and international governmental agencies, and (c) social-civic concerns such as marriage and divorce, child welfare, crime prevention, housing, and religious and racial conflicts which are not centered in organized institutions. This category, more than any other, includes man's thoughts about the nature and origins of knowledge and about its bearings upon his cultural life; it includes the relations of the individual to the traditions and ideals of his society, to its standards of truth and value, its modes of thinking, its ways of acting and feeling—in short, it includes the relations of the individual to the funded experience and social heritage of the human race.

ARTICULATION OF HIGH-SCHOOL CHEMISTRY AND COLLEGE CHEMISTRY

By Wm. B. Meldrum

In view of the high quality of work in chemistry as offered in many preparatory schools it is no longer desirable to include in the same general chemistry course in college those who have had chemistry in school with those who have had no chemistry. Nor is the plan of offering two general chemistry courses, one elementary for those who have not had chemistry in school, and one more advanced for those who have had chemistry previously, much more satisfactory. This plan is essentially a procedure of retarding the better-prepared students until the others have caught up to them so that all may enter the same second-year course. A much more desirable set-up of courses, which has worked well at Haverford College for several years, is to offer a first elementary course for beginners and a more advanced course into which both those who have taken the beginning course in college and those

who have had satisfactory courses in preparatory school may be admitted. This advanced course, which is given concurrently with the laboratory work in systematic qualitative analysis, deals with the fundamental chemical theory, with the main emphasis upon the ionization theory and its application to solution effects and to electrolytic effects, and upon the theory of atomic structure and its application to explain and correlate the properties of substances and the mechanisms of chemical reactions. It includes, however, a review of the fundamental laws and theories of chemistry and the development of the background, both factual and historical, of the ionization theory and the theory of atomic structure. The course not only affords a general view of the science of chemistry but also prepares the student for the application of physical chemistry in the more advanced courses. Several years' experience has shown that the grade in the chemistry examination of the College Entrance Examination Board is the best basis for the prediction of a student's success in such a course distinctly more advanced than the usual general chemistry course in colleges.

REPORT OF THE NEW WORK OF THE COLLEGE ENTRANCE EXAMINATION BOARD

By Robert N. Hilkert (as reported by the Secretary)

Mr. Hilkert reported on the proposed revision of entrance examinations in science, a sequence to the recommendation "that steps be taken toward the realization of a more nearly continuous secondary curriculum in science and a comprehensive examination in science be held by the Board. . . ."

The following statements are copied from a leaflet on the proposed revisions.

"With respect to present examination offerings of the Board, the Commission believes that . . . the Board should restrict itself to the major subjects: physics, chemistry, biology.

"With respect to the nature of the present examinations, the Commission is of the opinion that existing examining methods are in some respects inadequate and in need of improvement. It is therefore recommended that, during the next four years, the Board make an intensive study of the effectiveness of examining procedures in biology, chemistry and physics."

As for future examinations "the Commission recognizes three levels of attainment. . . .

"The scheme of examinations recommended here may be summarized as follows:

First level—biology, chemistry, physics.

Second level—biological sciences, physical sciences.

Third level—biology, chemistry, physics, including mathematics gamma."

Respectfully submitted,

DENA D. UNGEMACH,
Secretary-Treasurer

A meeting of the Executive Council was called immediately following the regular meeting. A number of questions from Mr. Meister's report, program, and membership were discussed. It was the consensus of the group that its members should meet again some time after the A. A. A. S. meeting in late December. The Council adjourned to meet at the call of the President.

DENA D. UNGEMACH,
Secretary

MINUTES OF THE TENTH ANNUAL MEETING OF THE NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

New Orleans, Louisiana, February 20th, 21st, 22nd, 23rd, 1937

Headquarters: *Hotel St. Charles.*

The dinner meeting was held on Sunday evening, February 21st, at six-thirty o'clock in Room "B" of the Hotel St. Charles.

The meeting was called to order by the president, Walter G. Whitman. The first item of business was the report of the Secretary-Treasurer, S. Ralph Powers. The reading of the minutes was dispensed with for the reason that they had been distributed to the members by mail. The report of the Treasurer was presented and accepted. A copy of the report is appended.

The next items of business were the reports of the several committees of the Association.

1. Report of the Committee on Scientific Attitudes, Ralph C. Bedell, *Chairman.*

"The Scientific Attitudes Committee submits the following suggestions for the investigation of the problem of scientific attitudes:

1. The definition of the general term "attitude."

The committee proposes to survey the field of psychology and to consult authorities in that field to determine if possible the consensus of opinion on the definition of the general term "attitude" as used in the psychological literature.

2. A definition of "scientific attitude."

The committee proposes to survey the field of science education to determine the usages of the term "scientific attitude." The result of this survey will be compared with that of No. 1 above in an attempt to formulate a definition of "scientific attitude."

3. A list of controlling scientific attitudes.

The committee proposes to prepare a list of scientific attitudes which will be in conformity with the above investigation. These attitudes are to be of the type that control and influence behavior.

4. The constructing of measuring instruments which will measure the above determined scientific attitudes.
5. The use of the above measuring instruments in such investigations as the com-

mittee and the N.A.R.S.T. may consider desirable."

Ralph C. Bedell, *Chairman.*

2. A report of the Committee on Publications was made by the Secretary in the absence of the *Chairman,* E. D. Heiss. The report was accepted as one of progress.

3. Report of the Committee of Five, Ralph K. Watkins, *Chairman.*

"Brief progress reports of the following committees were made (1) by M. L. Robertson and Gerald Craig on certain phases of the work of the Committee on Elementary School Science; (2) by Ellsworth S. Obourn for the Committee on Secondary School Science. These reports indicated progress in the work undertaken by these two committees. It would seem advisable to continue the work of these committees.

No report was available from the Committee on Science for Adult Education, nor from the Committee on Junior College Science. These two committees were later than the others in getting under way. Little has been accomplished by them to date. It was left to the Executive Committee, in consultation with the chairman of these committees, to determine whether or not their work should be continued.

In the absence of the chairman of the Committee on Elementary Science, the complete report for that committee was not available. The report was mailed to the chairman of the Committee of Five at the meeting but was lost in transit. A copy of the chairman's report will be made available to the Executive Committee.

The chairman of the Committee on the Education of Science Teachers, R. K. Watkins, presented a 25-page mimeographed report for the committee. The report consisted of a statement of issues confronting those concerned with the training of science teachers, a resolution of these issues in terms of available published studies, and bibliographies dealing with each issue. The issues were presented by the committee to the organization at the St. Louis meeting. A few copies of the mimeographed report are still available from the chairman.

It was agreed that this committee should be continued. The chairman was instructed to present a plan for continued investigation by the committee.

An informal report of the work of the Committee of Five as a whole was presented by the chairman, R. K. Watkins. It was recommended that the name, "Committee of Five," be dropped in order that a flexible group of committees which vary in number from time to time could be established.

It was suggested that those committees be continued by the Executive Committee that give promise of setting up a program of investigation that can engage the cooperative efforts of the members of the organization.

It was recommended that the chairman of committees break up the work agreed upon by each committee so that pieces of the total might be done by individuals, or possibly by institutions, working at some distance from one another. It would seem feasible for the chairman to synthesize the parts into one report, or for a committee to organize its materials into one report at a meeting held at the time of the annual meeting of the N.A.R.S.T. Assignment of work and agreement upon policies among members of a committee can be carried out by correspondence.

It does not seem wise to spend organization funds for committee meetings, nor as a means of subsidizing actual research. Committees can reasonably expect from the organization, funds for correspondence, duplicating, and for the ultimate publication of reports of work accomplished. Actual investigation will need to be carried out by individuals as members of a committee, or by individuals with the aid of local institutions."

Ralph K. Watkins, *Chairman.*

4. Supplementary report as a part of the work of the Committee of Five. Martin L. Robertson.

5. The Executive Committee was instructed to give consideration to publicizing the work of the Association.

6. Report of preliminary committee on Problems of Guidance in Science, Ralph C. Bedell, *Chairman.*

"1. There is general agreement among educators on the basic philosophy of guidance. This philosophy is variously stated but in general, means that the function of guidance is to enable each student to make the best possible adjustment for himself to the society in which he lives. Guidance workers generally delimit such adjustment to some such phases as the following:

a. health; b. educational; c. vocational; d. personal.

2. From the standpoint of science education it appears that it would be justifiable to assume a basic philosophy stated in the following terms:

The function of guidance in relation to science education is primarily one which brings each student into the best possible adjustment to the scientific phases of society.

This would include essentially best adjustment to science courses in school, scientific vocations, and scientific aspects of health.

3. Experts in the field of guidance are not in agreement on the methodology which is best suited to the accomplishment of the above purposes. After a rather careful survey of the field, it is the suggestion of the committee that the best methodology will be based upon a complete, permanent, cumulative, case history of each student.

   In this case history would be included academic records, personal records, free-time activity records, health records, and such other material that would seem to be significant. Each student's education would then be prescribed for him in terms of this case history.

   This would mean that the essential points of guidance would consist of:

   a. description; b. diagnosis; c. prescription; d. prognosis.

   Scientific education prescribed in this manner would constitute the nearest approach to a scientific method of teaching science.

4. The N.A.R.S.T. could contribute valuable information to the field of guidance by sponsoring investigations which would assist in the determination of the predictive value of various measurable human traits, singularly and in combination.

   As one illustration of the above, the organization might sponsor an investigation which would attempt to determine the types of people who are best fitted for laboratory method of instruction as in contrast with those who could profit most from the lecture method of instruction. Most investigations on the efficiency of the lecture method have not taken into consideration such pupil traits as manipulation rate, clerical aptitude, finger dexterity, spatial relations, and the like. This group might sponsor a series of such investigations which would try to discover the types of people who could profit best from each type of science instruction.

   Another example of the type of investigation this organization might sponsor would be a matter of differential prediction of success in various non-science courses compared with various science courses. This appears to be a valuable field which has had relatively little exploration.

5. In view of the increased guidance activities of schools, it would seem desirable for the N.A.R.S.T. to continue and enlarge the present guidance committee in view of conducting investigations along the above and similar lines."

Ralph C. Bedell.

The members in attendance at the dinner meeting were:

H. J. Arnold	Ellsworth S. Obourn
Otis W. Caldwell	Charles J. Pieper
Harry A. Carpenter	S. Ralph Powers
Gerald S. Craig	Martin L. Robertson
Francis D. Curtis	Ralph K. Watkins
Robert J. Havighurst	Hanor A. Webb
Lillian Hethershaw	Walter G. Whitman
George W. Hunter	Edward E. Wildman
	George E. Wood

The meeting was adjourned at 10:30 P. M.

The second session of the tenth annual meeting was convened at the Association of Commerce Building, on Monday morning, February, 22nd, at 9:30 A. M. Mr. Walter G. Whitman, presiding.

The Nominating Committee, consisting of Ralph K. Watkins, Edward E. Wildman, and George W. Hunter, recommended the following officers for 1937:

President—Hanor A. Webb.

Vice-President—S. Ralph Powers.

Secretary-Treasurer—Ellsworth S. Obourn.

Members at large of the Executive Committee—Walter G. Whitman and Fred G. Anibal.

Representative on Science Education (Board)—S. Ralph Powers.

The report of the Nominating Committee was adopted.

The program of the morning was a Panel Discussion of the Preliminary Report of the Science Committee to the Commission on Secondary School Curriculum of the Progressive Education Association.

The third session of the tenth annual meeting was convened at the Association of Commerce Building at 9:00 A. M., Tuesday, February 23rd. This was a joint meeting with the American Educational Research Association. The program was conducted as scheduled except for the paper by A. W. Hurd, who was absent. Mr. Walter G. Whitman presided.

Minutes of the Meeting of the Executive Committee of the National Association for Research in Science Teaching

Business transacted by correspondence following the last meeting which was held in St. Louis, Mo., February, 1936.

1. Appointed Ralph C. Bedell Chairman of the Committee on Scientific Attitudes in place of Francis D. Curtis who resigned.

2. Appointed the following to act as a Committee on Syllabus in Science for College Entrance: Ralph E. Horton, *Chairman;* Ellis Haworth; Morris Meister; Homer LeSourd, and Ellsworth S. Obourn. This committee will cooperate with the College Entrance Examination Board in offering suggestions for suitable two-year courses in Physical Science and in Biological Science.

The Executive Committee of the N.A.R.S.T. held its annual meeting on February 22, 1937, at the De Soto Hotel in New Orleans, La., with the following members present: Ellsworth S. Obourn, S. Ralph Powers, Hanor A. Webb, and Walter G. Whitman.

The application for membership of Dr. Cyrus W. Barnes of New York University was favorably considered and the Secretary instructed to conduct the required membership poll of the Association.

Hanor A. Webb was designated as the official delegate of the Association to the meeting of the American Science Teachers Association at Indianapolis, Ind., in December, 1937.

The following committees were appointed for the ensuing year:

1. Program Committee
   Martin L. Robertson, *Chairman*
   Gerald S. Craig
   E. E. Wildman
   Anita D. Laton
2. Publications Committee
   E. D. Heiss, *Chairman*
   R. J. Havighurst
   Charles J. Pieper
   John A. Hollinger

The following were discontinued:

1. Committee to draw up a List of Active Investigators in the Field of Science Education, Victor H. Noll, *Chairman*
2. Committee on Scientific Attitudes, Ralph C. Bedell, *Chairman*.

Mr. Walter G. Whitman, representing the Executive Committee of the Association, was delegated to consider and present to the next meeting any proposed changes in the Constitution or By-Laws.

The printing of a directory of the membership of the association was voted, the Secretary to obtain bids.

The following bills were presented and ordered paid:

To Ralph K. Watkins, for mimeographing, $20.00.

To Ellsworth S. Obourn, for mimeographing, $26.20.

Respectfully submitted,
Ellsworth S. Obourn,
Secretary-Treasurer

Treasurer's Report
February, 1937

Balance–February, 1936		$672.27
Received dues for 1936:		
62 members at $5.00	$310.00	
Received late dues for 1935:		
2 members at $5.00	$ 10.00	
Received donation to the Association from Harry A. Carpenter	$ 50.00	
Bank Interest	$ 7.53	
Total Receipts		$1049.80
Expenditures:		
To A. G. Seiler for printing programs of St. Louis meeting	$ 15.30	
To A. G. Seiler for printing programs of New Orleans meeting	$ 13.36	
To A. G. Seiler for printing 1935–1936 Directory of Members	$47.69	
To C. M. Pruitt for 67 subscriptions to *Science Education* at $2.00	$134.00	
To W. G. Whitman for postage	$ 3.60	
To Teachers College for 100 postal cards	$ 1.00	
Total Expenditures		$ 214.95
Balance February, 1937		$ 834.85

Submitted by S. Ralph Powers.

Abstracts

SCIENCE

SMITH, PHILIP H. "Breeding Machine Brains." *Scientific American* 155: 5–8; July, 1936.

Machines have been given the sense of sight, taste, touch, bearing, balance, and direction—will "brains" be next? Some of the modern labor-saving devices are described in this article. —C.M.P.

CURRAN, C. H. "How Insects Protect Their Eggs." *Natural History* 37: 441–456; May, 1936.

The author describes some of the strange ways in which insects protect their eggs and provide for the care and feeding of offspring they will never see. There are 22 illustrations. —C.M.P.

WOLF, WILLIAM. "Uncle Sam Fights a New Drug Menace—Marijuana." *Popular Science Monthly* 128: 14–15, 119–120; May, 1936.

Marijuana, better known as Indian Hemp, within the last five years has become a national menace. Another ten years of its phenomenal spread and the suppression of opium, heroin, cocaine, and similar drugs will have been as simple tasks. The plant is not new as it has been in this country ever since the days of the early colonists who cultivated it to obtain rope fiber. It is now a more or less common weed along the roadside of most states of the union. It is most commonly used in smoking, often either as a cigarette or in a doped cigarette. It is especially a menace to the young as many high-school students are using it. It is thought that many crime waves may be attributed to it, especially those of a cruel and revolting nature. —C.M.P.

ELLSWORTH, LINCOLN. "My Flight Across Antarctica." *The National Geographic Magazine* 70: 1–35; July, 1936.

This excellent article, with 38 illustrations, describes the author's recent 1935–36 flight across the South Pole in which he surveyed 120,000 square miles of previously unexplored territory. Ellsworth was recently awarded the Hubbard Medal of the National Geographic Society. —C.M.P.

MINER, ROY WALDO. "Sea Creatures of Our Atlantic Shores." *The National Geographic Magazine* 70: 209–231; August, 1936.

This article describes some of the common shore life of the North Atlantic. There are eight paintings in color by Else Bostel Mann. —C.M.P.

ATKINSON, AGNES AKIN. "Where Birds and Little Animals Find Haven." *The National Geographic Magazine* 70: 232–241; August, 1936.

This most interesting article describes the animal life in the Eaton Canyon Bird and Game Sanctuary near Pasadena, California. —C.M.P.

JENKS, GEORGE ELWOOD. "Life Story of the Black Widow and Her Insect Enemy." *Popular Science Monthly* 129: 32–34; August, 1936.

This is a series of 24 photographs showing how the Black Widow mates, rears her young, and may be destroyed by a tiny parasitic fly that lays its eggs on the surface of the egg sac of the Black Widow. —C.M.P.

ABBOTT, C. G. "The Influence of Solar Variability on Weather." *Scientific Monthly* 43: 108–121; August, 1936.

Dr. Abbott presents evidence that fluctuation of the intensity of the sun's radiation is an important factor in weather changes. A series of 14 interesting charts is included. There seem to be weather cycles of 11, 23, 46, and 92 years duration. Results of long distance weather forecasting covering a period of three years is included. Forecasts were fairly successful for precipitation and less so for temperature. —C.M.P.

RUSSELL, HENRY NORRIS. "Are We Inside a Dark Nebula?" *Scientific American* 155: 16–17; July, 1936.

Recent investigations suggest that our part of space is slightly hazy. Should this prove to be the case, it would provide a hypothesis of the origin of the sun's family of comets—a question that has long perplexed astronomers. —C.M.P.

AARON, S. F. "Misinterpreted Animal Observations." *Scientific American* 155: 84–87; August, 1936.

The author shows that many things which have been considered as detriments to protective coloration are actually protective in the highest sense—to the helpless young. Thus the species are aided in survival. Many illustrations are cited in the article. —C.M.P.

WASHBURN, BRADFORD. "Exploring Yukon's Glacial Stronghold." *The National Geographic Magazine* 69: 715–748; June, 1936.

This article describes the 1935 Yukon expedition of the National Geographic Society. There are 28 illustrations and a map. —C.M.P.

STEVENS, CAPT. ALBERT W. "The Scientific Results of the World-Record Stratosphere Flight." *The National Geographic Magazine* 69: 693–712; June, 1936.

Capt. Stevens enumerates the scientific accomplishments of the world-record stratosphere flight over South Dakota on November 11, 1935, when an elevation of 72,395 feet (13.71 miles) was reached. Capt. Stevens and Captain Orvil A. Anderson were awarded the Hubbard Memorial Medal for this successful flight. A special supplement—a photograph from the highest altitude ever attained by man—is included in this issue. —C.M.P.

SWANN, W. F. G. "Is the Universe Running Down?" *Scientific Monthly* 42: 498–516; June, 1936.

This is the Penrose Memorial Lecture of 1935 of the American Philosophical Society. The author discusses the pros and cons as to whether the second law of thermodynamics applies to the universe and comes to the conclusion that it does. —C.M.P.

WINTER, S. R. "Frauds That Flourish Until Uncle Sam Takes a Hand." *Hygeia* 14: 418–421; May, 1936.

In the United States Post Office Department, there is a particular division which has as its function the protection of the public from all kinds of fakers who use the mail as a means to get their wares before the public. Inspectors who handle mail frauds relating to medicine "have some years run down as many as fifty fakers whose business receipts totaled $5,000,000 annually."

Usually the person defrauded makes the complaint. The products are then tested by the Food and Drug Administration of the Department of Agriculture or by the Bureau of Standards to find out whether the product could possibly do what it is advertised to do. Results of the investigation are then given to the Post Office Department which decides whether or not a fraud order should be issued. If such an order is passed, "the postman in the office at which the offender receives mail is instructed to stamp all communications addressed to the person as 'fraudulent' and return to the sender." Records show that for almost every known disease there has been put on the market a medicine fraud. The author gives many examples of frauds perpetrated on the public. —F.G.B.

CLENDENING, LOGAN. "The Doctor Abroad—Egypt." *Hygeia* 14: 896–899, 944–949; October, 1936.

In this, the first of a series of articles relating to the development of medicine, the author takes the reader to Egypt where there are many proofs of early medical knowledge. In the Royal Museum in Cairo evidences are seen in mummies and their preparation. At the pyramids of Sakkara is the tomb of Sisa, a physician of the sixth dynasty. On the walls of this tomb are depicted the physician bandaging wounds and administering medicine. The temple Philae is a magnificent monument to Imhotep, a physician who upon his death was made the God of healing and who "is the first figure of a physician to stand out clearly from antiquity." Mummies, sculptures, and paintings with their accompanying hieroglyphics give evidences of early diseases of Egyptian peoples, such as infantile paralysis, tuberculosis, hardening of arteries, and trachoma. —F.G.B.

CLENDENING, LOGAN. "The Doctor Abroad—Italy." Part I. *Hygeia* 14: 1008–1011, 1013; November, 1936.

A traveler in Italy has opportunity to learn much about the history of medicine. At Salerno one may visit the spot where the greatest medical school of medieval times was located. Although nothing remains of the buildings, the visitor has the feeling of being in the atmosphere "of a great tradition of the past." The various museums of Naples contain early Roman and Graeco-Roman surgical instruments. An exquisite cathedral in Orvieta commemorates what was thought at the time to be a miracle but what is known now to have been a growth of red mold on the bread that was being used in the Holy Sacrament.

Paintings and sculptures depicting the two great plague Saints, Saint Sebastian and Saint Roche, appealing for discontinuance of the plague are prevalent throughout Italy and especially abundant in Venice. To understand the significance of the architecture in the Church of Santa Maria Della Salute in Venice, it is necessary to know that this church is distinctly a "plague church." Three other "plague" churches in Venice are the churches of Saint Roche, Saint Sebastian, and Saint Job. —F.G.B.

CLENDENING, LOGAN. "The Doctor Abroad—Italy." Part II. *Hygeia* 14: 1102–1105, 1112, 1147–1148, 1150; December, 1936.

The traveler will see in the portico of the Uffizzi, Florence, Italy, a statue of Andrea Cesalpino who is said to have formulated the theory of the circulation of the blood before it was given to the public by Harvey. In Campo Santo of Pisa still hangs the "Lamp of Galileo" from whose swaying Galileo evolved the principle of the pendulum and established the practice of counting pulse beats. This stimulated him to make an instrument for showing the rate of pulse beats which proved to be fundamental in scientific diagnosis. In Verona is the statue of Hieronymus Fracastorius who wrote an important treatise on contagion and described the cause, symptoms, and treatment of syphilis. In Bologna, the first medical course in Europe was taught in the oldest university in the world. In Padua, the student of materia medica will be interested

in the oldest botanic garden in Europe. In Pistoria medical interest centers in the old Hospital de Ceppo. On the lintels of the old porchway are figures by Della Robbia that represent scenes of ill patients and their attending physicians. —F.G.B.

CLENDENING, LOGAN. "The Doctor Abroad—France." Part I. *Hygeia* 15: 46–49; January, 1937.

In this article, the fourth in the travel-series, the author takes the reader to the Faculté de Medecine in the ancient city of Montpellier, France. One of the graduates of this school is usually called the father of surgery. Another graduate wrote the first strictly medical book printed in the English language. A monument in the park in the heart of Tours reminds the traveler of three great physicians, Bretonneau, Velpeau, and Trousseau. Back of the Cathedral in Chartres the visitor sees a monument to Louis Pasteur on which is depicted the scene on the surrounding plains where Pasteur proved to the world that it is possible to protect against infectious diseases by immunization. —F.G.B.

JOHNSON, ALLEN S. "Athlete's Heart." *Hygeia* 14: 880–881; October, 1936.

A physician discusses the facts relating to the common belief regarding the dangers of athlete's heart. He states that "there is no convincing evidence that a healthy heart is damaged by strenuous or even violent exercise. Fatigue causes one to quit before one can injure the heart itself." It is likely that inadequate means of determining heart conditions in the past have permitted some young men with abnormal hearts to participate in vigorous sports. —F.G.B.

Anonymous. "New Power from the Sun." *Popular Mechanics* 66: 546–548, 118A–120A; October, 1936.

The article discusses new data correlating radio disturbance with the sun's activity and something of Dr. Abbott's work in utilizing the sun's energy to develop power.

—O. E. Underhill.

Anonymous. "Exploring Up and Down." *Popular Mechanics* 66: 530–533, 121A; October, 1936.

This is a brief summary of research from Goddard's rockets in the stratosphere to Beebe's bathysphere in the deep sea, and new methods of deep drilling for oil, *etcetera*.

—O. E. Underhill.

CADY, LEE D. "Carbon Monoxide Poisoning." *Hygeia* 14: 986–988; November, 1936.

The author discusses characteristics of carbon monoxide and its effect on all red-blooded animals. He points out common places of danger from the gas. He suggests a procedure to follow in rescuing a person who has been overcome by it and gives explicit directions for administering artificial respiration. —F.G.B.

SKINNER, GEORGE H. "Winter Insects versus Health." *Hygeia* 14: 993–996; November, 1936.

Even during the winter months man must guard his home and other buildings from insect pests. The author reviews the life histories, dangers from, and ways of exterminating bed bugs, lice, cockroaches, and fleas. He has incorporated in the article the results of the latest investigations of these insects by proficient entomologists. —F.G.B.

LEFKOWITZ, LOUIS L. "Common Household Accidents." *Hygeia* 14: 1672–1675; December, 1936.

Inventive genius has brought into the home many products that save labor and time and bring comfort to man. Many of these products, if operated carelessly or ignorantly, may become hazards to health and even life itself.

The author enumerates the most common causes of accidents in the home, such as carbon monoxide in illuminating gas, in escaping gas from furnaces and stoves, and in the exhaust of automobiles; electricity in its use in common electrical appliances; common cleaning agents—gasoline, kerosene, benzine, and naphtha; drugs and chemicals commonly kept in medicine chests; ways in which wounds are cared for; and common dangers to which young children are often subject. He discusses the ordinary dangers from these causes and gives definite directions for reducing the number of commonplace accidents.

—F.G.B.

PLUMMER, WILLIAM A. "The Quest for Iodine." *Hygeia* 14: 527–530, 371; June, 1936.

In this article, the author considers simple or non-toxic goiter and measures used in preventing it. This type of goiter is largely endemic in regions where there is a deficiency of iodine. Although iodine itself was not discovered until 1811 and was first used in the treatment of goiter in 1820, substances containing iodine have been used in goiter treatment since antiquity.

The first controlled experimentation in an effort to solve the problem of goiter prevention in man was set up in Akron, Ohio, in 1917. In this study, iodine deficiency was found to be an important cause of goiter but not the only one. The author discusses some of the many methods for the administration of prophylactic quantities of iodine that have been tried out since the Akron study. It has been found that in regions where simple goiter is endemic that salt, a universally used food product, seems to be the natural vehicle for the distribution of iodine as a prophylactic measure. —F.G.B.

CADY, LEE D. "Snakes in the Service of Science." *Hygeia* 14: 784–786; September, 1936.

The author first discusses the violent action caused by poison of snakes when uncontrolled and then considers how these poisons may be controlled and put to good use. He tells that

when toxins of venoms are introduced in gradually increasing amounts into the body of an animal, antibodies will develop, thus immunizing the animal. The serums taken from such immunized animals have been used successfully in treating non-immune persons. He goes on to say that through experimentation it has been demonstrated that venom dilutions have "actually caused many chronic 'bleeders' to stop bleeding." Through further experimentation, it has been found that diluted germ free daboia venom is a "successful medicine to apply to any sort of bleeding." —F.G.B.

ARMAGNAC, ALDEN P. "New Feats of Chemical Wizards Remake the World We Live In." *Popular Science Monthly* 129: 9–11, 109; July, 1936.

This interesting article describes the amazing ways in which the chemists of the laboratory are creating new materials to serve the everyday needs of man. Among the recent developments are included a new synthetic fiber that is one-third thinner than natural silk—a pound ball of which would stretch across the country, a million pounds of sugar can be recovered annually as a by-product of starch manufacture, synthetic rubber, gasoline from coal, fuel alcohol from corn, glass with many new properties, and new kinds of dyes. —C.M.P.

STETSON, HARLAN T. "The Influence of the Sun on Human Affairs." *Scientific Monthly* 43: 14–22. July, 1936.

The author discusses the following as probable influences of the sun on human affairs: (1) Generation of powerful electromagnetic fields; (2) Three hundred years' observations show sunspots come and go in definite cycles of about eleven years; (3) Magnetic changes in the earth accompany the rise and fall of sunspots; (4) Greater auroral displays at times of sunspot maxima; (5) Radio-transmission affected; (6) Amount of ultra violet light varies with amount and quality of solar radiation which varies 3 or 4 percent; (7) Sunspots affect biological behavior; (8) May affect directly the growth and character of foodstuffs; (9) Physiological and psychological behavior may be affected; (10) Affects weather cycles on earth; and (11) May affect economic conditions as these conditions are related to psychological and physiological behavior. —C.M.P.

COLE, H. N. "The Skin in Health and Disease." Part I. *Hygeia* 14: 247–250; March, 1936.

The author first considers the character and importance of the skin and the skin as an interpreter of general health conditions. He devotes a large part of the article to certain diseases that are limited entirely to the skin. Many such conditions are caused directly by occupations followed such as "the baker's dermatitis due to irritation from powdered sugar, cinnamon and flour; the eruption seen in the florist and gardener from Chinese primrose; a breaking out on the hands of the rubber worker, caused by dyes, and in the case of the printer by ink and turpentine; and the irritation of the skin of the photographer by metol, an aniline dye used in developing." Some eruptions of the skin are caused by animal parasites such as the tick and itch mite. Some skin disturbances result from the use of inferior cosmetics. Many cases of irritation of the skin are due to the improper use of home remedies or of "patent medicines," salves and ointments. —F.G.B.

BURTON, WALTER E. "Beware of the Tick." *Hygeia* 14: 324–328; April, 1936.

In this article, the author points out some of the ways in which a small group of scientists contribute important benefits to the public. These scientists are research workers studying ticks under the direction of Dr. F. C. Bishopp, who is in charge of the division of the Bureau of Entomology that studies insects affecting man and other animals.

Probably the most deadly tick-carried disease is Rocky Mountain spotted fever. Other tick-carried diseases affecting man are Tularemia or rabbit fever, relapsing fever, and a peculiar form of paralysis. Ticks are also studied in connection with their attack on cows, sheep, chickens, ducks and other farm animals. The author discusses various ways of eliminating ticks and protecting man and other animals from them. —F.G.B.

GWATHMEY, JAMES T. "General Anesthesia." *Hygeia* 14: 109–112; February, 1936.

This article gives a record of the high lights in the historical development of anesthesia. Ether in the form in which it is now used, was discovered in 1540, but over three hundred years passed before it was used successfully in surgical operations. It is generally accepted that modern anesthesia dates from October 16, 1846, when Dr. William T. G. Morton, a dentist, gave the first successful public demonstration using ether as an anesthetic. At this time Oliver Wendell Holmes, the poet and essayist, coined the term "anesthesia." Chloroform and ethyl chloride were first used as anesthetics in 1847.

In 1908, a study was begun to find means of overcoming asphyxiation which resulted in the demonstration of the value of oxygen and carbon dioxide for this purpose. This important discovery made safer all agents and methods of anesthetics.

The author concludes by discussing various new anesthetics and methods of administration that have been brought out constantly since the beginning of the use of anesthetics in surgical work. —F.G.B.

New Publications

BRIDGMAN, P. W. *The Nature of Physical Theory.* Princeton: Princeton University Press, 1936. 138 p. $2.00.

The author of this work is the Hollis Professor of Mathematics and Natural Philosophy at Harvard University. As may be judged from this the text of the book is of a philosophical nature. The work is scholarly and shows a great deal of thought in its preparation. In the preface the author states that the text has been expounded from a series of three Vanuxen lectures given at Princeton University in 1935. It is an attempt to bring order out of the "extended material of experimental physics to order and understandability." A list of few of the chapter heads will serve to show the general trend of the text. "Logic," "Mathematics," "Relativity," "Wave Mechanics," are some of the outstanding chapters. This work is a reliable reference in Natural Philosophy in colleges. It may serve as a suitable reference in the essentials of the philosophy of the chapter heads listed above. In places the author's reasoning is difficult to follow but his material is accurate and correct in detail. —F. L. Herman.

BELL, THELMA HARRINGTON, AND BELL, CORYDON. *See America First Coloring Book.* Cleveland: The Harter Publishing Company, 1934. 48 p. $0.10.

Reading stories of interesting places to see in the United States and coloring the accompanying outline pictures according to simple directions given in the stories, will help boys and girls become better acquainted with their own country. The coloring may be done by use of water color paints, crayons, or colored pencils. A chart in the back of the book may be used to record interesting places that have been visited or that may be visited. This is a paper covered book appropriate for boys and girls in third and fourth grades. —F.G.B.

BELL, THELMA HARRINGTON, AND BELL, CORYDON. *Nature Paint Book.* Cleveland: The Harter Publishing Co., 1933. 48 p. $0.10.

On each page of this book is an outline picture of animals and plants and a story giving interesting information and directions for coloring the picture. Water color paints, crayons, or colored pencils may be used. The materials in the book have been checked for authenticity by the Director of the Cleveland Museum of Natural History. The vocabulary has been checked for children in grades two and three. A chart in the back of the book may be filled in as the child sees birds and flowers in the out-of-doors. This is an inexpensive paper covered book that provides interesting and profitable activity for seven, eight, or nine year old children. —F.G.B.

ATHEY, LILLIAN COX. *Along Nature's Trails.* New York: The American Book Company, 1936. 338 p. $1.20.

A collection of pleasing nature stories of trails and tracks, birds, insects, and other animals, trees and flowers. It is intended for children of about 9 to 14 years. —O. E. Underhill.

PEATTIE, RODERICK. *Rambles in Europe.* New York: American Book Company, 1934. 247 p. $0.72.

This is a cleverly done geography reader. The author is a professor of geography in Ohio State University. The preface does not indicate the intended grade placement of the volume. The reviewer would place it in grade four, or possibly five.

The book is written in narrative style. The narrative concerns the travels of five children, four boys and a girl, accompanied by the author. The countries visited are France, Spain, Andorra, Italy, Germany, Switzerland, Holland, and England. Illustrations are black and white drawings. Especially interesting are the illustrated maps showing the progress of the journey. Differences in customs, industries, and lives of people are explained by references to fundamental geographic causes.

Teachers of fourth and fifth grades should examine this book in making up new library lists. —R.K.W.

BUROS, OSCAR K. *Educational, Psychological, and Personality Tests of 1933, 1934, and 1935.* New Brunswick, N. J.: Rutgers University, 1936. 83 p. $0.50.

This is a bibliography of tests of the kinds indicated by the title. The pamphlet is the second in a series from the School of Education of Rutgers University. The first is out of print so that this volume is cumulative and includes the titles of the preceding. It is planned that the next in the series will include only newly published tests.

Annotations are factual giving the price and group for which the test is intended. There are no critical comments. Users of tests and teachers of education courses dealing with tests will find this listing exceedingly useful. The proposed service in keeping such lists up-to-date is to be commended. —R.K.W.

EDWARDS, EVA D. *Haruko, Child of Japan.* San Francisco: Harr Wagner, 1934. 200 p. $1.00.

This little volume would ordinarily be classified as a geography reader for the grades. The author has tried, however, to do something more. It is the purpose of the writer to build up tolerance and good-will on the part of the American children for their Japanese neighbors. She has enlisted the interest of the Japanese Consul, Mr. Tomokazo Hori, and Miss Hefferman, supervisor of elementary education in California, in the enterprise.

The story is concerned with a Japanese girl, Haruko, her brother, and her playmates. The story opens with the family in Japan and follows them to America where the father is to work on the ranch of a brother. There is also a return trip to Japan. The remainder deals with Japanese manners and customs woven into the daily lives of Haruko and her family.

The reviewer would place this book at about third or fourth grade level. It will be of special interest to elementary school teachers in California. Other teachers may find it useful in geography classes. —R.K.W.

SCOTT, J. M. *The Polar Regions.* New York: Oxford University Press. 100 p. $2.00.

This volume contains no text other than the brief introduction. It gives a glimpse of the arctic and the antarctic regions in a series of more than one hundred artistic photographs. The pictures are arranged into the following groupings: outward voyage, arctic scenery, arctic animals, antarctic animals, arctic peoples, polar transport, spring and summer, polar industries, and polar incidents.

The photographs probably give a better understanding of the polar regions than twice the number of pages given to explanations. The book should be a welcome addition to any high school library. —R.K.W.

PEAKE, HAROLD J. *Early Steps in Human Progress.* Philadelphia: J. B. Lippincott and Company, 1933. 256 p. $3.00.

This is the book of understandable anthropology for which a host of readers have been waiting. The writer is British, a former president of the Royal Anthropological Institute and of the Anthropological Section of the British Association. The volume is copiously illustrated with photographs, largely from world famous museums.

An unusual feature of the organization is the centering of the cultural development of man about the story of the building up of means of satisfying human needs. The introductory chapters deal with the types of man, ancestral types, and existing types, and with the anthropologist's system of measuring time. The other chapters are concerned with early tools, the discovery of fire, weapons, the taming of animals, the development of grain growing, early mills, the history of the house, land and water transport, the first working of metals, the inventions of writing, and so on. Comparisons are made between the finds taken from excavations and the uses of similar artifacts to be found among existing primitive tribes.

The book is to be recommended to the general reader, to high school teachers of science, history, and geography, and to senior high school pupils. Here is a valuable addition to the senior high school library. —R.K.W.

MIRSKY, JEANNETTE. *To the North.* New York: Viking Press, 1934. 386 p. $3.75.

Readers with an interest in stories of arctic exploration will be able to lay this book aside with great difficulty. It is a history of exploration in the far north from the time of the earliest available records to the present.

The author has adhered closely to her original sources. An extensive bibliography is available in the appendix. A map in the rear enables the reader to keep the various expeditions separated. Although well documented, the style is such that the volume may be classed with those intended for the lay reader. Much that will be new to most citizens is presented in the earlier chapters dealing with the first excursions into the North.

The book is recommended for popular reading. It is not too difficult for pupils in senior high schools and will make an admirable addition to many high school libraries. Teachers of geography and history should be familiar with its content. —R.K.W.

BERTELLI, LUIGI. *The Emperor of the Ants.* New York: Thomas Y. Crowell Company, 1935. 240 p. $1.50.

A translation from the Italian, a delightfully droll and instructive story of insect life, written around the adventures of a little Italian schoolboy who, wearying of his lessons, is changed on his desire to an ant. Particularly readable for children of eight to twelve, but enjoyable even to adults. The edition is attractive; it makes excellent supplementary reading material in connection with the life of insects. —L.M.S.

BEATY, JOHN Y. *Story Pictures of Farm Animals.* 1934. 155 p. *Story Pictures of Farm Foods.* 1935. 191 p. *Story Pictures of Farm Work.* 1936. 128 p. Chicago: Beckley-Cardy Company. $.70 each.

These three books are a series of primary books dealing with farm life. They can be used as a basis for the farm unit in the primary social studies curriculum. The objectives are stated as follows:

1. To develop an appreciation of farm life and the work of the farmer.
2. To emphasize man's dependence on the farm for food and clothing.
3. To show the relationship between the farm, food, and the home.

4. To widen the child's horizon through the presentation of material understandable because of past experience and environment.

Story Pictures of Farm Animals describes farm animals, the care which the farmer gives them, and the use of these animals by man. It is illustrated with excellent photographs.

Story Pictures of Farm Foods describes the many foods grown or produced on the farm, how they are prepared, and how they reach the city stores. The book is descriptive and a bit tasky for young children in contrast with the other two of the series. No attempt is made to give the geographical sources of the various foods. In view of much good reading material included it is unfortunate that the book contains scientific inaccuracies, such as: classing the sweet potato as a tuber; the edible part of the cauliflower as a seed head and "a head of white stems on which the seeds grow"; honey bees gathering "honey" from the apple tree. The book is illustrated with interesting photographs.

Story Pictures of Farm Work tells about the farmer's daily work in typical farm surroundings. It takes its departure from a trip which a grade of children made to a farm. It is well illustrated by photographs of farm life.

L.M.S.

PETERSHAM, MAUD AND MISKA. *The Story Book of Wheels.* Chicago: The John C. Winston Company, 1935. 32 p. $.60.

This story tells in a clear and interesting way the part wheels have played in man's progress. It tells how they probably came into use; how the early ones were made; how they serve to lighten the work of man; and their importance to-day in transportation, industry, and everyday work. The language is simple and direct. Any boy or girl interested in the romance of accomplishment will find this book delightful and instructive. It will stimulate the reader to a greater appreciation and understanding of the contributions of men of past ages to the achievements of to-day. On each page is a beautifully colored illustration. This book should find an important place in school and home libraries.

—F.G.B.

PETERSHAM, MAUD AND MISKA. *The Story Book of Clothes.* Chicago: The John C. Winston Company, 1933. 32 p. $.60.

This is one of a series of books entitled *The Story Books of Things We Use.* The author tells the young reader about the different kinds of materials that have been used for clothing throughout the ages, such as fur, bark of trees, grass, wool, silk, flax, and cotton. Some idea is given about the ways in which these materials are prepared for cloth. Illustrations in color, one on each page, add much to the attractiveness of the book. The book is written for children in third and fourth grades. —F.G.B.

PETERSHAM, MAUD AND MISKA. *The Story Book of Iron and Steel.* Chicago: The John C. Winston Company, 1935. 32 p. $.60.

This is one of a series of four books entitled *The Story Books of Earth's Treasures* that tell the stories of gold, coal, iron, and oil. In this book, the author traces the history of iron from its accidental discovery by early man to the present time with its many uses and modern methods of manufacture. The book will appeal to boys and girls who like true stories telling of progress that has made possible man's present achievements. On each page is an attractive and appropriate illustration printed in color. —F.G.B.

NIDA, WILLIAM L. *Man Conquers the World with Science.* Chicago: Albert Whitman and Company, 1934. 256 p. $1.25.

This is Book VI in a series of books on *The Story of Man.* It deals with *Communication* and *Transportation,* giving the history of each from earliest records up to the present time in a style readable by a ten-year-old child. The book is carefully written; the illustrations are fair. This is an excellent supplementary reader for general science and should be in every school reference library. —L.M.S.

TOWSE, ANNA B., MATHEWS, FLORENCE E., AND GRAY, WILLIAM S. *Health Stores.* Book Three. Chicago: Scott, Foresman and Company, 1935. 208 p. $0.76.

This is the third unit of a group of Health books in the Curriculum Foundation Series; it is intended for the third grade. It is divided into seven parts: Keeping Clean; Building a Strong Body; Caring for Our Bodies; Food Habits; Keeping Sickness Away; Keeping Safe; Keeping Happy. The material is based on children's experiences which afford opportunity for health training. "The main objective of this book is to help form attitudes which will lead to desirable health behavior from the standpoint of the physical, mental, social, and moral well-being of the child." The material is scientific, interestingly written, illustrated in color, and should prove acceptable to both children and teacher.

—L.M.S.

BEAUCHAMP, WILBUR L., CRAMPTON, GERTRUDE, AND GRAY, WILLIAM S. *I Wonder Why? Science Stories.* Book One. Chicago: The Reilly and Lee Company, 1933. 144 p. $1.00.

This delightful book may be correlated with any first grade reader. It is divided into five parts devoted to *Seasons, Weather, Animals, Plants,* and *Sun, Moon and Stars.* Each part contains stories of real experiences of children at home and at school. Fundamental scientific ideas form the foundation of these stories, the science content is authentic, and the authors attempt to introduce problem solving by observation and experiment in the interpretation of the environment.

The book is charmingly and generously illustrated in color and will be well liked by children.
—L.M.S.

COBB, WALTER FRANK. *Health for Body and Mind.* New York: D. Appleton-Century Company, 1936. 515 p. $1.60.

This text seems very well designed to achieve its purpose as stated by its authors. "The purpose of this text is to present the principles that govern the hygiene of the body and mind in such a way that they may have a larger share than heretofore in helping forward these ideals." Of course the final test of such success can be made only by observing, over a period of years, the behavior of those who have studied it; something that is well-nigh impossible to carry out. The material is presented in a straightforward manner, yet with an easy and informal style. The approach to the problems of personal hygiene seems to be well calculated to influence the behavior of the individual. Topics such as racial hygiene, preparation for marriage and parenthood, care of the sick and injured, philosophy of the handicapped, vacation hygiene, industrial health, nutrition, the endocrines, proprietary medicines, etc., are well handled. The book is illustrated with some excellent photographs and many thought-provoking diagrams, charts, and pictograms. A specialist in the field of health education asked by the reviewer to comment on the text says, "This seems like a splendid text for the secondary school. The author weaves together so well the anatomical and physiological facts with pertinent hygienic facts that students should appreciate the interrelation." The thirty-six chapters are so planned that each may be developed in one, two or three lessons, thus making the text flexible enough to use as the basis for one, two or three years of hygiene. The experience of the author eminently qualifies him for writing such a text and the credit given in the preface to Dr. Paul B. Mann, of New York City, and Dr. Hanor A. Webb, of George Peabody College for Teachers, indicates that sound educational theory is embodied in its organization.
—O. E. Underhill.

CURTMAN, LOUIS J. *A Brief Course in Qualitative Chemical Analysis.* New York: The Macmillan Company, 1936. 249 p. $2.25.

This book is to be commended for its excellent theoretical treatment of the laws of chemical equilibrium covering ionization, solubility products, complexion formation and oxidation-reduction. Emphasis is given to equation writing to express the reactions which take place. Theory and laboratory work are closely coordinated throughout. The book provides for a one-semester course. Valuable data is provided in the appendix.
—W.G.W.

LONG, J. S., ANDERSON, H. V., AND HAZELHURST, T. H. *Qualitative Analysis.* New York: Prentice-Hall, Inc., 1935. 259 p.

This revision of a well-known qualitative analysis manual improves on the earlier editions by expanding some portions, rewriting sections to conform with more recent developments in theory and adding some new material. A number of minor changes have been made in organization to make the text more readable.
—O. E. Underhill.

REH, FRANK. *Astronomy for the Layman.* New York: D. Appleton-Century Company, 1936. 308 p. $3.00.

Astronomy for the Layman is a unique book. In it, poetical quotations are woven in with an elementary and popularized discussion of the science of Astronomy. The purpose of the book is twofold: "To relate and explain fascinating phenomena of Astronomy in a manner calculated to appeal to the interested amateur and layman, and to quote and explain astronomical allusions of poets of all times and many lands. In this way the author hopes that lovers of Astronomy will acquire a new interest in their contemplation of the heavens and, at the same time, that lovers of poetry will enjoy to a fuller degree many passages which become clear only with some knowledge of the Astronomical phenomena to which they refer." The book is recommended, especially, to persons who like poetry blended in with their science.
—E.D.H.

PINCUS, GREGORY. *The Eggs of Mammals.* New York: The Macmillan Company, 1936. 160 p. $3.75.

This is the first volume of a new series of Experimental Biology Monographs. Other volumes now ready are *Pacemakers in Relation to Aspects of Behavior* and *Neuroembryology.* Yet others are in preparation.

The author's statement of purpose is as follows: "The behavior of mammalian eggs from the time of their genesis in the ovary to their implantation in the uterus is the subject-matter of this book. The attempt has been made to include experimental investigations of the growth and development of ova rather than morphological descriptions."

A considerable previous training in biology is necessary for the reader to interpret the findings of the experiments recorded. Certain implications are of considerable interest to the science teacher. For example, the suggestion of discarding the Weismann germ-plasm theory in light of better knowledge of the origin of ova in the bodies of mammals should be of considerable concern.

The book is not intended for the lay reader. It is recommended to high school and college teachers of biology. It belongs also in the biological section of college libraries. Except for the teachers it will be of little value in high-school libraries.
—R.K.W.

WALTON, EVERETT P., AND FOSS, PHILIP E. *Social Biology*. Philadelphia: P. Blakiston and Company, Inc., 1936. 572 p. $1.68.

A new method of approach for secondary-school science. Amply illustrated with interesting and clear photographs and drawings. Material found in this secondary-school science text is arranged in an interesting, readable manner, and should attract the interest and attention of secondary-school boys and girls. The material is arranged in well-planned units, followed by questions and projects so that the student can be encouraged to go further than the pages of the text.

It seems that this book should find great favor in those schools where children have had some outdoor contcasts. It will furnish an excellent reference in grade schools and junior high schools. It is recommended to those who want easy, clear, understandable reading matter in science. The print is clear, very legible and easily read. The paper is of high quality, and the printing is well done. —Ezra C. Harrah.

PEATTIE, DONALD CULROSS. *Green Laurels; The Lives and Achievements of the Great Naturalists*. New York: Simon and Schuster, 1936. 368 p. $3.75.

This biography is different from those we usually see. It is a topical presentation, rather than an account of the lives and work of selected naturalists. Indeed the men named are primarily used as outposts or stages in the advance of certain lines of scientific thinking. More than that, the author has his own peculiar artistic and literary ideas about how to treat the development of thought. and uses his characters as occasions for presenting his own ways of thinking. The job is excellently done. The panorama-like or kaleidoscope-like view of what has happened in science may be even more fundamental than had the author recounted each man's life and work in the usual fashion.

The "Schoolmen and Herbalists" are named incidentally as the story is told of how curiosity-driven wanderers sought new plants and animals, and as the more artistic ones produced the matchless paintings which make up most of the herbals of royal days. Then, the physicians of early days hunted their own "simples," which were the herbs they concocted into medicines. Thus, early medical practice, half-superstitious, forced an alliance with the naturalist, since as the author says, "All medicine begins in magic." Aristotle comes along as the early great philosopher who sought, too largely it is true by introspective reflection, to bring order from the chaos of the reports brought in by the collecting naturalists.

The significance of microscopes is told. Especial attention is drawn to the ways in which early microscopy served to sharpen human eyes, and how "the times themselves were grinding the mental lens." Malpighi studied living cells and found "why it is that man draws breath." Leeuwenbhoek "found the corpuscles of the life stream," and Harvey electrified his century by his "announcement of the circulation of the blood." The gruesome fact that Harvey and many others had to die in order that their discoveries might live are old tales of the tragedies of science. Such tales are still full of meaning when we consider the intolerance of ignorance which continues, by somewhat more refined methods, to crucify those whose ideas do not conform to accepted modes.

Buffon and Réaumur saw much that was new to science, but the court of Louis XV wanted science that extolled royal highness. So, in France science became a queer mixture of really great observations, occasions for praising their rulers, and inoffensive obeisance to false notions too prevalent to be disturbed. Cuvier and Linnaeus, more devoted to truth as they could see it, are characters of supreme importance in the history of science. And Darwin, Huxley, and the other Greats, were real truth-seekers and defenders. The *status quo* bothered them less, and what is the real truth bothered them more, thus science prospered. The author properly gives high place to Linnaeus. Scientists now-a-days may well pause to view again the large amount of Linnaeus' work which still stands. Of course, many false steps are recognized, just as a hundred years from now our own false steps will be recognized. Lamarck soon followed and corrected certain errors that existed, produced new high-order contributions, and left the tracks of his own false steps. Even his late physical blindness did not deprive him of great mental insight. And the sharpening of wits between him and the truly great Cuvier, as they fought for truth as they saw it, provides fascinating reading.

The Wilderness Plantsmen (Bartram and Michaux), Wilderness Birdsmen (Wilson and Audubon), and Robert Owen and his son David Dale Owen, are given abundant recognition for their important contributions to the new world of science. Indeed, the author has an especially receptive eye for the romance of science as displayed by those picturesque and non-conforming wanderers. Goethe's writings and the romanticists are presented under the title "Rose Spectacles," and the author himself has invested in eye-glasses which come under that caption.

The story of concomitant discovery and development of theory by Wallace and Darwin is well told, and new slants are given. Strangely, the closing chapter is devoted to "Fabre and the Epic Commonplace." It is a fascinating chapter and its facts provide abundant opportunity for use of unusual literary ability, which the author surely employs. Possibly the closing sentence from one of the first chapters may best close this review. "The whole story of science, the whole burden of this book, is the endeavor of the human intellect to clear its vision, in order to support the white light of day shining on naked reality in all its beauty." —O.W.C.

DAVIS, IRA C., AND SHARP, RICHARD W. *Science: A Story of Progress and Discovery.* New York: Henry Holt and Company, 1936. 491 p. $1.72.

This new textbook for ninth-grade classes is organized in 20 chapters or "units." Of these, approximately sixteen deal with physical science and four with biological science including physiology, health and plant growth. In physical science, the topics treated include air, fire, heat. weather and climate, water, light, sound, electricity and magnetism, machines, power and transportation, energy, and some geology. Each chapter is introduced by a statement chiefly historical in character which gives the background of the topic to be presented. Following this are questions to be answered by study of the chapter. At intervals throughout the presentation and at the end of each chapter there are questions for review. Each topic is completed with a brief summary statement. A biographical glossary, a bibliography for supplementary reading and an index, complete the book. It contains a wealth of illustrations, including sketches, drawings and photographs. Much attention is given to exercises and suggestions for the development of scientific attitudes. The book is well-printed and attractively bound.

In their treatment of the subject, the authors are to be commended for their constantly evident determination to present science accurately and fully. No half-way measures or compromise with scientific truth are tolerated at any point. Due at least in part to this laudable resolve they sometimes give the impression of being too thorough and of going into the matter under discussion to the point of dullness—that is, to ninth-grade pupils. Some of the material included seems better adapted to a textbook in physics for the twelfth grade than a ninth grade general-science class. Such matters as a careful analysis of the parts of the human ear and their respective functions (p. 214–215), the rather intricate operation of valves and piston in an internal combustion engine through the complete cycle (p. 310–311), the presentation of fairly complicated electrical circuits (p. 253), to mention but a few, seem matters which would be of rather remote interest to the average fourteen-year-old boy or girl.

One further criticism would be that more space might well have been devoted to biological science. The maximum proportion that could be said to be devoted to this field here is one-fourth of the total. Unless the book is intended only for those who will follow it with a course in biology this is not enough.

Except for these possible weaknesses, the book under review is an admirable piece of work. It errs on the side of going too deeply rather than on the side of superficiality. This is by all odds the more desirable of the two. The work is scholarly, complete and accurate. It is remarkably free of errors, both scientific and typographical. The authors, as well as the publisher, are to be commended for a substantial contribution to this field. —V.H.N.

DAVIS, IRA C. *Directed Study Guide and Manual.* (To accompany Davis & Sharpe's "Science"). New York: Henry Holt and Company, 1936. 194 p. $0.60.

The book is essentially a set of questions and exercises based on the textbook which it follows closely. There are several sets of questions of various types on each chapter and questions for review of each chapter. Occasional groups of questions are used to help pupils identify and acquire scientific attitudes. There are relatively few illustrations and not many experiments for the pupil.

This manual is thorough and accurate. It is, perhaps, more suitable for use by the teacher than by the pupil. Most pupils will probably not do all the exercises and answer all the questions included. However, the teacher will find a wealth of material for directed study from which may be chosen as little or much as desired.

—V.H.N.

WATKINS, RALPH K., AND BEDELL, RALPH C. *General Science for Today.* New York: The Macmillan Company, 1936. 715 p. $1.72.

This is a revision of an earlier book by the same authors. The purpose of the revision has been to bring the book up to date and to put into effect suggestions growing out of several years use of the book in the classroom. The presentation is in three major parts, the first discussing the world about us, the second introducing the general principles by which man controls natural forces, and the third dealing with methods used by man to control these forces. The material is organized into fifteen units comprising 28 chapters. The last unit really constitutes a fourth part in that it deals in two chapters with scientific method and the scientific attitude. All the common branches of science are represented, there being 231 pages devoted to physics, 133 to biology, 30 to chemistry, 28 to astronomy, 43 to geology, 90 to hygiene and 21 to weather and climate. The book is profusely and intelligently illustrated, well printed, and written in an easy, engaging style. Each unit is begun with a brief introductory statement and a list of problems in the form of questions which study of the unit will help to answer. At the close of each chapter are lists of "Things to Do" and "Other Things to Do." At the end of each unit the pupil finds "unit organization activities" or things to do bearing a relation to the whole unit; also, a list of facts and principles brought out in the unit and a list of references for supplementary reading.

This work has undoubtedly had wide adoption and a deserved wide use. It ranks with the best available textbooks in the field. The approach in presenting the material is a natural one, beginning with the world about us and gradually developing the idea of control by man of his en-

vironment. That the material is drawn largely from the physical sciences is not unusual and perhaps as it should be. The authors claim to give more space to biological science than most such books do. In this one, approximately 17 per cent. of the space is given to biology. Even if one were to classify hygiene separately, just a little less than 70 per cent. of the book goes to physics, chemistry, astronomy, geology, weather and climate. Whether or not this allotment of space is correct is a matter of some doubt. It would be much more acceptable if the course in which this book is used were followed for every pupil by one in biology. This is probably the case in many instances. —V.H.N.

HOLME, C. G. *Modern Photography.* New York: The Studio Publications, Inc., 1936–1937. 111 p. $3.50.

This is a British publication of illustrations of fine photography. There is practically no text material. The photographs speak for themselves. The collection is international in its scope. Subjects are extremely varied. Six color photographs are included in this edition.

The introduction summarizes the technical data for each photograph, giving the name of the photographer, the place, the kind of camera used, lens data, film, light, and so on.

Any person interested in art can well spend a few hours with this volume. It is of special interest to artists and art teachers. Science teachers with an interest in photography can learn much about the artistic effects that can be produced with certain technical manipulations of photography. A few high school pupils with ambitions in artistic photography may well study the volume. —R.K.W.

DESCHIN, JACOB. *New Ways in Photography.* New York: Whittlesey House, 1936. 307 p. $2.75.

New Ways in Photography supplements rather than duplicates the material found in the other books on photography reviewed in this issue. The book emphasizes primarily the methods employed in obtaining first-class photographs of all kinds of subjects under all conditions, in good and bad weather. It also discusses "trick" photography, night and indoor work, flashlights, double exposures, long-range photography, the making of photomurals and transparencies, posed scenes, re-touching and infra-red photography. This is a useful, practical book recommended to everyone interested in photography and especially to those who want to add something "extra" to their present knowledge and stock-in-trade.

Jacob Deschin conducts the column "Camera Angles" for the *Scientific American.*

—C.M.P.

MEES, C. E. KENNETH. *Photography.* New York: The Macmillan Company, 1937. 227 p. $3.00.

This book tells the story of photography from the art of the old-time professional with his tent and burdensome pack to the modern amateur who carries his motion-picture camera in his pocket. Dr. Mees is an outstanding authority, having been engaged in the art for the last thirty years and is Director of Research and Development of the Eastman Kodak Company.

In non-technical language Dr. Mees shows the great industry at work—in laboratories and commercial plants, in dark rooms and Hollywood studios with their mazes of apparatus. He portrays the working of photographic materials, their manufacture on a large scale, their various applications to photographic uses, color photography, motion-picture production, sound recording and synchronization, animated cartoons and amateur photography, both in stills and in motion. Many excellent illustrations supplement the textual material. —C.M.P.

NEBLETTE, C. B., BREHM, FREDERICK W., AND PRIEST, EVERETT L. *Elementary Photography.* New York: The Macmillan Company, 1936. 253 p. $0.76.

Studies of the interests of boys and girls indicates a relatively high degree of interest in photography. There is a strong appeal in pictures and picture-making. More than 750 secondary schools now have camera clubs in operation and it is estimated that there are more than 3,000 photography clubs in the United States. In many schools not having a camera club, work in photography forms an integral part of the science classwork or in the activities of the science club. Thus the work may be either curricular or extracurricular or both. As a unit of work in the regular science program, work in photography is based on sound pedagogical principles.

Elementary Photography is a book designed to meet these needs either on the curricular or the extracurricular basis. It is suitable for use on the junior-high-school level as well as the senior-high-school level. No assumption is made of previous courses in physics and chemistry. The usual phases of photographic work are covered with especial attention being paid to sequence of topics and the gradation of activities. There are 130 very helpful illustrations. The low price makes possible an individual copy for every club member or the placing of several copies on the science shelf for regular classwork. —C.M.P.

JORDAN, FRANKLIN I. *Photographic Enlarging.* Rochester: The Folmer Graflex Corporation. 1935. 224 p. $3.50.

In the foreword the author states "This book has been written to help photographers make better enlargements. Its purpose is to tell in plain and practical words some of the methods and devices which many photographers have found useful and convenient in their work. It is a compendium of the ideas of many people which one worker has collected for his own use and now passes on to others."

The techniques of enlargement are explained in some detail and those interested in photographic

enlargement will not find a more useful, practical reference.

However, this book is as useful to those not interested in this phase of photography, but only in taking, developing and printing pictures. What is said about the negative, the paper, exposing, development, fixing, washing, drying, spotting, combination printing, mounting and lantern slides will be of great practical value to all interested in photography—novice, amateur or professional. The book is to be highly recommended as a valuable addition to the science book-shelf of either the school library or the science teacher.

—C.M.P.

DAVIS, WILLIAM S. *Practical Amateur Photography.* Boston: Little, Brown and Company. 1935. 264 p. $2.25.

This is a revised edition of a book that the novice and amateur in photography will find most useful. It will serve as a general guide book. Practically all phases of photography are considered — cameras, plates, films, negatives, prints, developing, printing, retouching, spotting formulae, vignetting, inserting, blocking out, moving pictures, color photography, miniature cameras, etc. The textual material seems to be of a higher quality than the pictures used as illustrations. Often these would seem to have been in need of retouching or spotting.

The book will be found a useful addition to the high-school science shelf and for the personal use of all embryo photographers. —C.M.P.

Symposium: *Universal Photo Almanac and Market Guide.* 1937. New York: Falk Publishing Company, 1936. 215 p. $1.00.

This is a service booklet for the amateur photographer, especially those interested in selling free-lance photographs. There are several interesting articles including a bibliography and formulary of standard formulas. The section on "The Universal Market Guide" lists newspapers, magazines, trade papers, syndicates, calendar manufacturers and others who purchase free lance photographs. —C.M.P.

SPENCER, D. A. *Photography Today.* New York: Oxford Press, 1936. 160 p. $1.50.

This book by an English author offers some contrast to the books by American authors reviewed above. In arrangement the textual material follows more formal lines of presentation. It does not give as much detail and omits many of the "fads and fancys and tricks" in photography. The author is President of the Royal Photographic Society in London. There are many excellent photographs, serving as pertinent illustrations. However, there are several little "touches" given in this book that one does not find in other books—each photographer would seem to have had his own pet devices.

—C.M.P.

LEMON, HARVEY BRACE. *From Galileo to Cosmic Rays.* Chicago: The University of Chicago Press, 1934. 450 p. $3.00.

This is probably the most unique college textbook in elementary physics that has been written. In fact it is so different from the run-of-the-mine elementary physics textbook, that most readers would hardly guess that it is intended as a college textbook. Professor Lemon has humanized the more or less abstruse subject matter of physics in a style that is both enjoyable and readable. Here physics really lives—the formalism typical of the conventional physics textbook is non-existent. If secondary physics textbooks were written in the same lucid, living style—as if they were written to be read by boys and girls for the joy and pleasure of reading and knowing about the physical environment in which they live now—science teachers would not need to worry about a decreasing enrollment in physics.

Professor Lemon is professor of physics in the University of Chicago and is well known as a skillful demonstrator in his classroom teaching, often performing between 500 and 600 experiments in a year's lecture course.

From Galileo to Cosmic Rays is recommended both as a textbook and a supplementary reader in college survey courses, as a supplementary reader for secondary science, and as an authoritative, up-to-date book for laymen and for all science teachers. —C.M.P.

STEPHENSON, REGINALD J. *Exploring in Physics.* Chicago: The University of Chicago Press, 1935. 205 p. $1.50.

This is a manual providing stimulating problems to supplement *From Galileo to Cosmic Rays.* reviewed above. Problems are grouped under fifteen subdivisions of physics. Each subdivision has a few pages of discussion introducing the physical laws or principles. Examples and questions are scattered throughout the discussion. Pertinent and often intriguing illustrations add attractiveness to an excellent supplementary textbook of problems in college physics.

—C.M.P.

BARTKY, WALTER. *Highlights of Astronomy.* Chicago: The University of Chicago Press, 1935. 280 p. $2.50.

This is a text designed for the astronomical portion of the Introductory General Course in the Physical Sciences given at the University of Chicago. In the preface the author says:

"Existing books on astronomy were found to be not altogether satisfactory for our purpose; either they were too lengthy, or certain phases which we regarded as essential were omitted. The particular difficulty always encountered was the student's early discouragement when he could not locate for himself the stars and the planets in the sky. To eliminate this obstacle without the introduction of mathematics, certain simple charts have been constructed."

Thus this text is intended primarily for use in survey courses and constitutes an excellent text or supplementary book in astronomy for not only college science teachers but also for elementary science teachers, general science teachers and

secondary physical science teachers. It bridges the gap between the often too-technical textbooks and the just as often over-simplified popular treatises in astronomy.

The illustrations are simple, pertinent; the analogies illuminating. A stellarscope, an instrument that locates and names the stars by means of tiny sky maps on picture film, and which greatly simplifies the exact-identification of the heavenly bodies, may be had for two dollars. —C.M.P.

CRONEIS, CAREY, AND KRUMBEIN, WILLIAM C. *Down to Earth.* Chicago: The University of Chicago Press, 1936. 501 p. $3.75.

This is another of the "new-style" textbooks used in the survey courses at the University of Chicago. As in all the other texts in the series, the format is conspicuously different from the usual textbook. The book is written in large bold type, with a liberal use of black-face type and larger type for the initial words of paragraphs, and has ultra-modern, yet simplified diagrams and cartoons. Wide spacing of lines and paragraphs makes the book more readable.

Interesting headings of the chapters indicate the lively style with which the textual material itself has been written. Some of the chapter headings are: "End of the Line," "The Bounding Main," "Rivers of Ice," "The Everlasting Hills," "The Tooth of Time." "Universal Cemetery," "Vulcan's Chimneys" and "Prospects of an End." However, in no sense has the material been "written down."

There are a series of 64 rotogravure plates, grouped in a series of 16 plates each, at appropriate spaces in the book. These plates form a most attractive feature of the book.

In difficulty, *Down to Earth* is intermediate between the few popular accounts we have in geology and the more sedate textbooks. Teachers of science on all levels will find the book most useful and scientifically accurate. Its unique place is in survey courses and as a handy reference book in geology. —C.M.P.

WAGNER, NORTON. *Unveiling the Universe.* Scranton, Pa.: Research Publishers. 1936. 135 p. $1.00.

Unveiling the Universe is a unique book both in content and in format. There is a profusion of splendid illustrations and a wealth of explanatory material. It would probably be impossible to find a book on astronomy having so much material compressed in so little space. Were the book in ordinary size type it would be a volume probably twice as large. A vast amount of research must have preceded the writing of this volume and here one finds many unusual and interesting new facts. Another unusual feature of the book is the end opening.

This is a book to be recommended for the home library as well as the science library in school. It constitutes an excellent reference book for science teachers and is to be commended for use in science survey courses. The price is unusually low for a book of this kind. —C.M.P.

TAYLOR, FRANK J., AND TAYLOR, RUTH. *Our U.S.A.—A Gay Geography.* Boston: Little, Brown and Company, 1935. 112 p. $3.50.

This is an unusual geography. In rare humor, the authors have portrayed in 56 pictorial maps in bright colors the life of each state and territory in the union. Facing each map is textual material about the state or territory depicted. This is a book for the leisure hours—children will appreciate and enjoy the pictures and cartoons—adults will forget they are adults! This is not a book for those in whom a sense of humor is lacking, but if you enjoy clever cartoons, you'll enjoy this gay geography. —C.M.P.

BROADHURST, JEAN, AND GIVEN, LEILA I. *Microbiology Applied to Nursing.* Chicago: J. B. Lippincott Company, 1936. 564 p. $3.00.

Although written for nurses, students and teachers interested in the study of bacteria will find this book about the most useful book they can find on the subject. The authors have striven to make it a teachable book, hence it is quite readable and less technical than most books. There are numerous illuminating charts and many splendid diagrams.

Chapter headings are as follows: "Introductory Work with the Microscope"; "Cell Study"; "How Other Organisms Affect Our Welfare"; "Molds Including Yeast"; "Bacteria and Protozoa and Related Organisms"; "Cultivation of Bacteria"; "The Inhibition and Destruction of Bacteria"; "Bacterial Relations of Air, Soil and Water"; "Bacterial Relation of Foods, Including Milk"; "Disease Organisms: Their Transfer and Effects"; "The Body Reactions in Disease"; "Vaccines in Disease Control"; "Antiserums in Disease Control"; "Anaphylaxis"; "Tests: Immunity and Disease"; and "Disease Producing Organisms." —C.M.P.

EVANS, C. LOVATT, AND HARTRIDGE, H. *Starling's Principles of Human Physiology.* Philadelphia: Lee and Febiger, 1936. 1096 p. $8.75.

This is the seventh edition of a book first printed in 1912. This attests to the popularity of this classic work in the field of physiology. While distinctly a college textbook, it is not unduly technical. It is a source of accurate information based on a thorough digest of the experimental researches now going on in the fields of physiology and health. Considerable attention is paid to the rapidly developing field of biophysics and biochemistry, including vitamins. Practically every chapter has been revised and many sections rewritten. There are 554 illustrations.

This book is an excellent reference for the college and high-school biology classes.—C.M.P.

MARSHALL, CLYDE. *An Introduction to Human Anatomy.* Philadelphia: W. B. Saunders Company, 1935. 385 p. $2.50.

This is one of the most elementary texts in anatomy available to the secondary teacher of biological science. Technical details have been kept at a minimum, yet at no actual sacrifice in accuracy of fundamental facts and principles. It would seem that nothing necessary for giving a sound elementary course has been omitted or slighted.

This book is to be highly recommended to secondary biology teachers and other science teachers needing a scientifically accurate, simply-written textbook in anatomy. —C.M.P.

HILL, CHARLES. *A Manual of Normal Histology and Organography.* Philadelphia: W. B. Saunders Company, 1937. 530 p. $3.50.

This is the seventh edition of a book first appearing in 1906. It is one of the most elementary books of its kind that is available to secondary science teachers and teachers of college science desiring an elementary treatise of the subject. It is a most readable book and the fundamental facts are presented in a clear and concise manner. The chapters treating the cell, tissues, circulatory system, digestive system and respiratory system are especially good. There are 312 splendid illustrations. —C.M.P.

RICE, THURMAN B. *A Textbook of Bacteriology.* Philadelphia: W. B. Saunders Company, 1935. 551 p. $5.00.

Secondary science teachers will find this a most readable text in bacteriology, with technical vocabulary and detailed laboratory instructions for laboratory technic reduced to a minimum. The average chapter is relatively short, averaging less than 10 pages. There are 121 illustrations, but the work could be greatly enhanced by the inclusion of more illustrations of bacteria, including colored plates. Needless to say this would have greatly increased the price and undoubtedly was the reason for omitting them.—C.M.P.

FRENCH, SIDNEY J. *The Drama of Chemistry.* New York: The University Society, 1937. 170 p. $1.00.

The Drama of Chemistry is a meritorious addition to the popular University Series of Highlights of Modern Knowledge, so widely used in college survey courses in science. Written in delightful narrative style, this volume develops the science of chemistry through the medium of historical facts. Following an interesting section on the history of chemistry, there are chapters on the elements, their behavior and family relationships, atoms, valence, types of molecular structure, organic and biological chemistry, fuels and energy, organic synthesis, and chemistry in medicine. The final chapters deal with chemistry in a civilized world, the chemist and his problems, and the future of chemistry.

The reviewer recommends this book as excellent survey course material and as a supplementary text both in college and high-school chemistry courses. —C.M.P.

KARLSON, PAUL. *The World Around Us.* New York: Simon and Schuster, 1936. 293 p. $3.00.

"Here it is at last! A description of the world by modern science, which is at once technically accurate, delightfully interesting, and surprisingly lucid. Here at last is a supreme endeavor which bids fair to succeed where others have failed—Here is popularization at its best." So runs a notation from the Scientific Book Club regarding its November selection. The reviewer agrees that the book merits this high praise, for it indeed represents the finest attempt that has yet been made to make popular a branch of science that writers have found exceedingly difficult to popularize, namely, physics.

As in the laboratory researches where the work of the physicist cuts deeply across the work of the chemist, so does this book cut deeply across the subject matter of chemistry. Indeed it is a book popularizing chemistry as much as it does physics. Only in the lower elementary levels does there seem to be a differentiation, albeit artificial, between the two fields of knowledge.

This treatise is an American translation of a German work. The author is a German scientist of note, with a journalistic flair, as this most readable book proves. And he shows that in science there is no place for racial prejudice and bias.

Secondary students of physics and chemistry will find the book most readable. It is recommended most highly to science teachers and as an important supplementary book in survey courses.

Discussion of the theory of relativity is excellently done as are the newer ideas in atomic theory. Other divisions are: "The Bricks of the Universe;" "Electricity;" "Light Waves;" and "Light Quanta." —C.M.P.

BISHOP, A. H. B., AND LOCKET, G. H. *An Elementary Chemistry.* New York: Oxford University Press, 1936. 400 p. $1.75.

This is a surprisingly interesting book, considering the fact that few efforts were made by the authors to popularize their subject as in a modern American textbook in this field. The illustrations, for example, are extremely few and the great majority are simply line drawings. There are not more than fifteen photographs in the whole book and a total of only 133 illustrations. The book is well written in a style that is clear and succinct. The treatment of most topics is quite brief. Chemical equations are introduced on page 56 without any explanation of their meaning to the pupil. Valence, symbols, formulas and equations are described and once and for all five chapters later in a space of four and one-half pages. The book gives a little bit of everything but does not go deeply into anything. It is definitely a textbook written for the purpose of preparing pupils to pass the examinations for a school certificate. It is up-to-date and as interesting book with such a specific objective can well be. —V.H.N.

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